ISSN-0039-2502

Journal of the Association of Lunar & Planetary Observers

Founded in 1947

The Strolling Astronomer

Volume 54, Number 1, Winter 2012

Now in Portable Document Format (PDF) for Macintosh and PC-compatible computers

Online and in COLOR at http://www.alpo-astronomy.org

Inside this issue . . .

- *ALCon 2012 information*
- *What's REALLY up with those Venusian clouds?*
- *Whole-disk brightness measurements of Mars*
- *A 'Great White Spot' on Saturn?*
- *The Remote Planets in 2010 and 2011 . . . plus reports about your ALPO section activities and much, much more!*

Online image of the December 11, 2011 lunar eclipse taken by "Shutter Shooter" on the Gold Coast, Queensland, Australia. The first moon was taken at 10:30 pm local time, the second moon at 11:20 pm, the third moon 12:00midnight and the last blood-red moon was taken at 1:15 a.m. According to his web page, a Pentax X90 12.1 megapixel digital camera was used for image-capture, and Adobe PhotoShop CS5 was used to stitch the photos together and added a small amount of contrast/ brightness. Source: http://shutter-shooter.deviantart.com/art/Lunar-Eclipse-December-2011-273379748


ORION TELESCOPES & BINOCULARS
Since 1975
Your Affordable Astro-Imaging Source
#9534
#9530
ED80T CF
ED102T CF
ED80T Carbon Fiber Triplet Apochromatic Refractor
$799.99 #9534
ED102T Carbon Fiber Triplet Apochromatic Refractor
$1,999.99 #9530
The Leo Trio (M65, M66 and NGC 3628) – Taken with the Orion ED102T CF Refractor, StarShoot Pro V2.0, Orion Atlas EQ-G, and Orion StarShoot AutoGuider. 23 x 10 minute exposures combined. Orion image.
StarShoot™ G3 Deep Space Imaging Camera
$499.99 #53082 Color
$499.99 #53083 Mono
StarShoot™ AllSky Camera
$899.99
#52187
NTSC Std.
Magnificent Mini AutoGuider Package
$349.99 #24781
Parsec™ 10100C Color Astronomical Imaging Camera
$1,799.99 #52078
StarShoot™ Deep Space Video Camera
$499.99
#52185
NTSC Std.
SteadyPix™ Deluxe Camera Mount
$46.99 #5338
StarShoot™ Solar System Color Imaging Camera IV
$99.99 #52175
SteadyPix™ Telescope Photo Adapter for iPhone
$59.99 #5303
StarShoot™ 0.5x Focal Reducer
$44.99
#52086
Deluxe Off-Axis Guider
$129.99 #5521
1.25" Astrophotography Flip Mirror
$139.99 #5523
Prices subject to change. Dealer pricing and/or promotions may vary.
Orders: (800) 447-1001
Customer Service: (800) 676-1343
OrionTelescopes.com
Check out the Orion page on Facebook
www.facebook.com/oriontelescopes

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 54, No.1, Winter 2012
This issue published in January 2012 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:

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

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

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

Founded in 1947

In this issue

Inside the ALPO

Point of View: 2012 – The Year We Remain Right Here, Looking Up 3
News of General Interest 4
ALCon 2012 News 4
Dues Increase 4
Venus Volcano Watch 4
ALPO Interest Section Reports 5
ALPO Observing Section Reports 6

Feature Stories

Venus: Clouds and Chimeras, Self-Deception and Serendipity 13
Whole-Disk Brightness Measurements of Mars: 2009-2010 25
Is Saturn's Storm of the 2010-11 Apparition Related to The Great White Spot (GWS)? 30
ALPO Observations of Uranus and Neptune in 2010-2011 33

ALPO Resources

Board of Directors 39
Publications Staff 39
Interest Sections 39
Observing Sections 39
ALPO Publications 40
ALPO Staff E-mail Directory 41
Back Issues of The Strolling Astronomer 43

Our Advertisers

Orion Telescopes & Binoculars .... Inside Front Cover
ALPO 2011 Conference ad 2
Announcing the ALPO Lapel Pin 4
Catseye Collimation Systems/ Catsperch Observing Chairs 5
Sky Publishing .... Outside Back Cover

ALCon2012

Celebrate Starlight

CHICAGO, JULY 4-7, 2012

Celebrating 150 Years of Organized Astronomy: 1862–2012

FEATURED SPEAKERS:

- **Mike Simmons**, *President, Astronomers Without Borders*
- **Dr. Donald Parker**, *ALPO, Planetary Astrophotographer*
- **Dr. Dave Crawford**, *Co-founder IDA (remote presentation)*
- **Wally Pacholka**, *TWAN, Landscape Astrophotographer*
- **Dr. Jason Steffen**, *Kepler Mission Scientist*
- **Dr. Mark Hammergren**, *Adler Asteroid Expert*
- **Dr. Philipp Heck**, *Field Museum Meteorite Curator*
- **Dr. Hasan Padamsee**, *Physics Professor/Playwright, Cornell Univ.*
- **Vivian Hoette**, *Astronomy Educator at Yerkes Observatory*
- **Jeff Talman**, *Artist, Star Sound Installation, "Nature of the Night Sky"*
- **Dr. David Blask**, *Expert in circadian disruption/cancer/light pollution*
- **David Eicher**, *Editor-in-Chief, Astronomy Magazine*

- Morning talks: **Marriott Lincolnshire Resort** on Wed, Thur, Fri; Morning & afternoon talks on Sat; Daytrips* on Wed, Thur, Fri.
- **Very special early booking room rate at the Marriott $69+tax** (reg $169)
- Daytrips: Fermilab, Yerkes, Sailing, Field Museum, Adler Planetarium
- Workshop at Yerkes: Outreach for the sight/hearing impaired
- Saturday Awards Banquet and Star Party
- July 4th Fireworks and StarParty on Resort golf course
- StarBQue, StarParty and chamber music concert at Ravinia
- AL Urban Observing Challenge
- Official **NCRAL, ALPO** and **AWB** events
- **MWAIC** Astro-Imaging Conference Wed, Thu, Fri pm sessions
- Qualified **Teacher CPDU credits**
- Dark Sky Advocacy presentations and roundtable forum
- Celestial Arts Contest: photos, songs, poetry, 3-min videos, art

*Day trips dependent on required sign-ups

CALL FOR MATERIAL:

Call for Material for commemorative **"Celebrate Starlight" book and poster.**
Will be released at ALCon2012!
Submissions accepted until March 1, 2012.

Celebrate Starlight Book

We invite your astronomy organization to submit one to two pages describing its history. How do you want your association to be remembered? Let your organization's achievements, members & outreach SHINE on these pages!

Celebrate Starlight Poster

This commemorative poster will be a montage of club logos, famous faces, astrophotos and special projects. We invite each organization to send its logo and any other pertinent images that they wish to have included in this very unusual poster.

What constructed image will the montage represent? Come to ALCon 2012 and find out!

More information and registration:
alcon2012.astroleague.org

Special additions to the program:

- Visual Moonbounce by OPTICKS on July 4! directed by Daniela De Paulis
- Creation's Birthday, the play by Hasan Padamsee about Hubble and the birth of the Big Bang Theory

PARTNERS:

Robert A. Pritzker Center for Meteoritics and Polar Studies — The Field Museum
ADLER PLANETARIUM
Fermilab
Yerkes Observatory
Astronomical League
Chicago Astronomical Society
ALPO — Association of Lunar & Planetary Observers
Lincolnshire Resort Marriott
One Star at a Time
Astronomers Without Borders
Illinois Coalition for Responsible Outdoor Lighting
RAVINIA FESTIVAL
ida
MWAIC

StarShip Sail – July 5
Registered Tall Ship Windy II, a 149' 4-masted schooner.
Evening sail to learn celestial navigation and mythology.

www.birrendesign.com/astro.html - Objects in the Heavens 5th Edition

Inside the ALPO
Member, section and activity news

Association of Lunar & Planetary Observers (ALPO)

Board of Directors

Executive Director (Chair); Julius L. Benton, Jr.
Associate Director; Ken Poshedly
Member of the Board; Sanjay Limaye
Member of the Board; Donald C. Parker
Member of the Board; Ken Poshedly
Member of the Board; Michael D. Reynolds
Member of the Board; Richard W. Schmude, Jr.
Member of the Board; John E. Westfall
Member of the Board & Secretary/Treasurer; Matthew Will
Founder/Director Emeritus; Walter H. Haas

Publications

Editor & Publisher, Ken Poshedly

Primary Observing Section & Interest Section Staff

(See full listing in *ALPO Resources*)
Lunar& Planetary Training Section: Timothy J. Robertson
Solar Section: Kim Hay
Mercury Section: Frank Melillo
Venus Section: Julius L. Benton, Jr.
Mercury/Venus Transit Section: John E. Westfall
Lunar Section:
Lunar Transient Phenomena; Anthony Cook
Lunar Meteoritic Impact Search; Brian Cudnik
Lunar Topographical Studies & Selected Areas Program; Wayne Bailey
Mars Section: Roger Venable
Minor Planets Section: Frederick Pilcher
Jupiter Section: Richard W. Schmude, Jr.
Saturn Section: Julius L. Benton, Jr.
Remote Planets Section: Richard W. Schmude, Jr.
Comets Section: Gary Kronk
Meteors Section: Robert D. Lunsford
Meteorites Section: Dolores Hill
Computing Section: Larry Owens
Youth Section: Timothy J. Robertson
Historical Section: Richard Baum
Eclipse Section: Michael D. Reynolds
ALPO Website: Larry Owens

Point of View

2012 – The Year We Remain Right Here, Looking Up

By Ken Poshedly, editor & publisher, *The Strolling Astronomer*

Greetings and welcome to 2012! - the year to end all years, at least if you believe the hype put forth by Hollywood regarding the so-called Mayan calendar prediction that come December 21, 2012, we're all to experience the end of our planet.

My own belief is that most of us will be chuckling about the whole thing the morning of December 22, just like after the Y2K fiasco and the fears of worldwide computer crashes when 1999 left and 2000 entered. (Other than a few problems here and there, even “unprepared” computers survived nicely.)

Anyway, chances are that if it (the end of the Earth) does happen, it will not even be noticed by possible members of an ALPO-like group on another planet far, far away from us.

So what SHOULD we be looking forward to over the course of this year - and even after December 21? Besides Venus and Jupiter, both of which are currently available and beautifully placed each night for you post-sunset observers, some other highlights include the following:

- The solar transit of Venus on June 5 and 6. While the event will be best seen from locales in the Pacific Ocean, those in North America will be able to see at least the start of the transit. The next solar transit of Venus won't be until 2117, so get your observing plans set now. For more, go to the NASA Eclipse Website at http://eclipse.gsfc.nasa.gov/OH/transit12.html.

- Eclipses: Look for an annular solar eclipse on May 20, a partial lunar eclipse on June 4, a total solar eclipse on November 13, and a penumbral lunar eclipse on November 28. Again, For more, go to the NASA Eclipse Website at http://eclipse.gsfc.nasa.gov/OH/transit12.html.

Inside the ALPO
Member, section and activity news

News of General Interest

ALCon 2012 News

Look to the left of this page for a full-page ad with the latest info about this summer's next astro get-together when the ALPO joins the Astronomical League in Chicago.

Dues Increase

By Matt Will
ALPO membership secretary/ treasurer
matt.will@alpo-astronomy.org

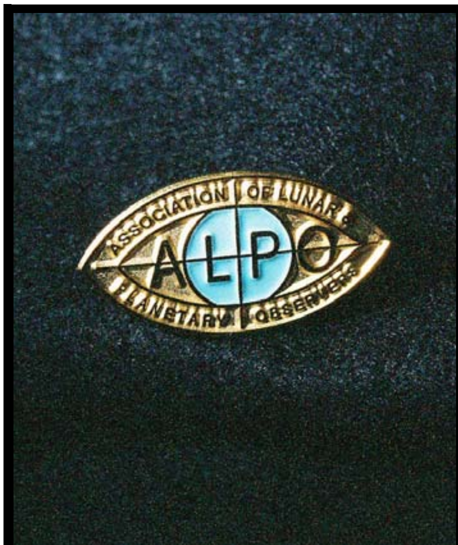
Unfortunately, a fact of life is that the cost of doing business rises with time. No one likes having to pay more for the same product. However, even though the ALPO tries to absorb as much of the cost as possible in producing the ALPO Journal and maintaining the business of the ALPO, eventually some decisions have to be made. Below is the new ALPO membership dues structure. This is the first increase in dues that we have had in three years. Please note that the digital membership dues will not increase, but all other categories will. The ALPO has tried to make this increase as modest as our finances will allow and we hope that you will stay with us as the ALPO continues its mission to distribute information and data concerning amateur studies of the Solar System. The new rates take effect on January 1, 2012, and are listed below:

- $US 12 (Digital Journal; All countries; 4 issues, e-mail address required) No change.
- $US 20 (Digital Journal; All countries; 8 issues, e-mail address required) No change.
- $US 33 (Paper Journal; USA, Canada and Mexico; 4 issues)
- $US 60 (Paper Journal; USA, Canada and Mexico; 8 issues)
- $US 40 (Paper Journal; Other countries; 4 issues)
- $US 74 (Paper Journal; Other countries; 8 issues)
- $US 65 (Digital and Paper Journal; Sustaining Member; 4 issues, all countries)
- $US 130 (Digital and Paper Journal; Sponsor; 4 issues all countries)

Remember, there are two ways to join/ renew:

- Complete and mail in a copy of your completed membership application from the back of this Journal.
- Online at http://www.astroleague.org/store/index.php

We are also very grateful for the support of those who choose to become Sponsors ($120 for four issues) or Sustaining Members ($60 for four issues). Both Sponsors and Sustaining Members receive both paper and digital versions of this Journal.



Announcing,
The ALPO Lapel Pin

Now you can display your affiliation with our fine organization proudly with the new, colorful ALPO Lapel Pin.

With bright raised gold lettering against a recessed gold sandblast finish, each pin features the pupil of the ALPO "eye" in fluorescent aqua blue. A "pinch" clasp at the rear secures the pin in place. Pin dimensions are 1 1/8 in. by 9/16 in.

Free for those who hold or purchase ALPO Sponsor level memberships.
Only $3.50 for those who hold or purchase Sustaining level memberships
Only $8.50 for all other ALPO members.
Not available to non-ALPO members.

Price includes shipping and handling.

Send orders to: ALPO, PO Box 13456, Springfield, IL 62791-3456. E-mail to: *matt.will@alpo-astronomy.org*

Venus Volcano Watch

By Michael F. Mattei
micmattei@comcast.net

We're down to the last suggested observing date for the Venus Volcano Watch — February 5. Watch for a bulge on the terminator where the uplifted sunlit clouds would show on the dark side of the terminator, and on the sunlit side, watch for bulges of circular cloud formation like the tops of cumulus clouds.

There are three volcanoes that are believed to be active; Maat Mons, Ozza Mons and Sapas Mons. All are near the equator centered near CM 165°. From research of cloud formations and lit clouds on the dark side and circular sunlit side clouds, it may be possible to deter-

Date	Location from Terminator
5 Feb 2012	Volcanoes at the bright limb.

Inside the ALPO
Member, section and activity news

mine if a volcano has erupted. A correlation of these observations can be made to locate volcanoes on the surface of Venus.

Observations should be made at all times because there may be many more volcanoes that could be active. I would be happy to receive observations, drawings, sketches, CCD images. Please be sure of the time in UT and location of observer.

See JALPO51, No. 1, page 21 for an article of the events and what they look like. You can find the article by going to http://www.alpo-astronomy.org/djalpo/51-1/JALPO51-1%20-%20Free.pdf

ALPO Interest Section Reports

Web Services

Larry Owens,
Section Coordinator
Larry.Owens@alpo-astronomy.org

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

Section Coordinators: If you need an ID for your section's blog, contact Larry Owens at larry.owens@alpo-astronomy.org

For details on all of the above, visit the ALPO home page online at www.alpo-astronomy.org

Computing Section

Larry Owens,
Section Coordinator,
Larry.Owens@alpo-astronomy.org

Important links:

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

Inside the ALPO
Member, section and activity news

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.

Meteors Section

Report by Bob Lundsford,
Section Coordinator
lunro.imo.usa@cox.net

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

Meteorites Section

Dolores Hill, Section Coordinator
dhill@lpl.arizona.edu

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

Comets Section

Gary Kronk,
Section Coordinator
kronk@cometography.com

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

Solar Section

Kim Hay, Section Coordinator,
kim.hay@alpo-astronomy.org

Remember to visit the ALPO Solar Section webpage at www.alpo-astronomy.org/solarblog for information and updated observations.

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

Mercury Section

Report by Frank J. Melillo,
Section Coordinator
frankj12@aol.com

The MESSENGER spacecraft continues to send back excellent surface images of Mercury. Just recently, the scientists had extended the mission after the first year expired in March 2012. There is a lot to learn yet, so hopefully the spacecraft will surprise us with many new discoveries.

The ALPO Mercury Section has been slow this year. Carl Roussell sent many excellent drawings while John Boudreau took many great images. In fact, some of his images are comparable with the MESSENGER. So far, the major features and the rayed craters are confirmed by the recent flybys. Once we get a full view of the surface of Mercury from all different angles, we can check further to see which other features can be seen from earth.

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

Venus Section

Report by Julius Benton,
Section Coordinator
jlbaina@msn.com

Currently Venus appears in the western sky after sunset at apparent visual magnitude -4.0, steadily distancing itself east of the Sun as it eventually approaches Greatest Elongation East on March 27, 2012. During the 2011-12 Eastern (Evening) Apparition, Venus is passing through its waning phases (a progression from fully illuminated through crescentic phases) as observers witness the leading hemisphere of Venus at the time of sunset on Earth. In mid-January, the gibbous disk of Venus will be nearly 14 arc-seconds across and 80.0% illuminated. The Table of Geocentric Phenomena in Universal Time (UT) is presented here for the convenience of observers for the 2011-12 Eastern (Evening) Apparition.

Observers have already begun contributing images and drawings of Venus, and many more will surely follow in the months to come. Readers are reminded that high-quality digital images of the planet taken in the near-UV and near-IR, as well as other wavelengths through

Geocentric Phenomena of the 2011-2012 Eastern (Evening) Apparition of Venus in Universal Time (UT)

Superior Conjunction	2011	Aug 16 (angular diameter = 9.6 arc-seconds)
Greatest Elongation East	2012	Mar 27 (46º east of the Sun)
Predicted Dichotomy	2012	Mar 29.34 (exactly half-phase)
Greatest Brilliancy	2012	Apr 28 (m_V = – 4.6)
Inferior Conjunction	2012	Jun 05 (angular diameter = 58.3 arc-seconds)

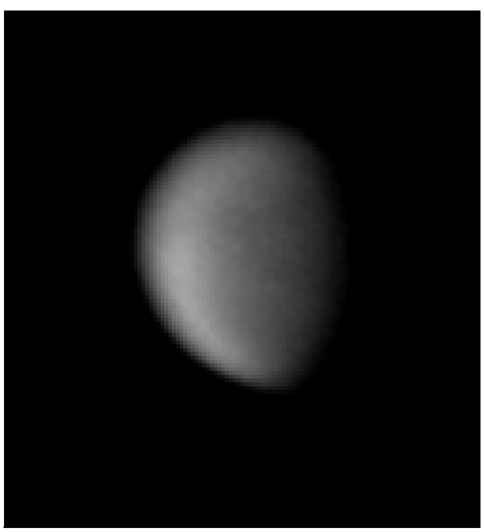
Inside the ALPO
Member, section and activity news

polarizing filters, continue to be needed by the Venus Express (VEX) mission, which started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006. This Professional-Amateur (Pro-Am) effort continues, and observers should submit images 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.

Regular Venus program activities (including drawings of Venus in Integrated Light and with color filters of known transmission) are also valuable throughout the period that VEX is observing the planet, which continues into 2011-12. Since Venus has a high surface brightness, it is potentially observable anytime it is far enough from the Sun to be safely observed.

The observation programs conducted by the ALPO Venus Saturn Section are



Digital image of the gibbous planet Venus as imaged on January 2, 2012 at 19:09 UT by Orlando Benìtez Sànchez of the Canary Islands. Equipment includes a 23.5 cm (9.25 in.) SCT and ultraviolet filter S = 6.0, Tr = 5.0. Apparent diameter of Venus is 13.1 arc-seconds, phase (k) 0.823 (82.2% illuminated), and visual magnitude -4.0. South is at top of image.

listed on the Venus page of the ALPO website at http://www.alpo-astronomy.org/venus as well as in considerable detail in the author's ALPO Venus Handbook available from the ALPO Venus Section. Observers are urged to carry out digital imaging of Venus at the same time that others are imaging or making visual drawings of the planet (i.e., simultaneous observations).

Although regular imaging of Venus in both UV, IR and other wavelengths is extremely important and highly encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates and reporting visual or color filter impressions of features seen or suspected in the atmosphere of the planet (e.g., categorization of dusky atmospheric markings, visibility of cusp caps and cusp bands, measurement of cusp extensions, monitoring for the Schröter phase effect near the date of predicted dichotomy, and looking for terminator irregularities).

Routine use of the standard ALPO Venus observing forms will help observers know what needs to be reported in addition to supporting information such as telescope aperture and type, UT date and time, magnifications and filters used, seeing and transparency conditions, etc.

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

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

Lunar Section:

Lunar Topographical Studies / Selected Areas Program

Report by Wayne Bailey, Program Coordinator
wayne.bailey@alpo-astronomy.org

The ALPO Lunar Topographical Studies Section (ALPO LTSS) received a total of 95 new observations from 12 observers during the July-September quarter. Ten contributed articles were published, and eight observations included extensive comments.

The Focus-On series in *The Lunar Observer* newsletter continued with articles on Plato, and Posidonius. Upcoming Focus-On subjects include Mare Humorum, Copernicus, and Archimedes.

Visit the following online web sites for more info:

- The Moon-Wiki: the-moon.wikispaces.com/Introduction
- Chandrayaan-1 M3: pds-imaging.jpl.nasa.gov/portal/chandrayaan-1_mission.html
- LROC: lroc.sese.asu.edu/EPO/LROC/lroc.php
- ALPO Lunar Topographical Studies Section moon.scopesandscapes.com/alpo-topo
- ALPO Lunar Selected Areas Program moon.scopesandscapes.com/alpo-sap.html
- ALPO Lunar Topographical Studies moon.scopesandscapes.com/alpo-topo
- The Lunar Observer (current issue) moon.scopesandscapes.com/tlo.pdf
- The Lunar Observer (back issues) moon.scopesandscapes.com/tlo_back.html
- Banded Craters Program: moon.scopesandscapes.com/alpo-bcp.html
- The Lunar Discussion Group: tech.groups.yahoo.com/group/Moon-ALPO/

Inside the ALPO
Member, section and activity news

Table Lunar Calendar for First Quarter, 2012 - All Times UT

Jan. 01	06:15	First Quarter
Jan. 02	20:20	Moon at Apogee (404,579 km – 251,394 miles)
Jan. 02	24:00	Moon 4.8 Degrees NNW of Jupiter
Jan. 06	21:48	Extreme North Declination
Jan. 09	07:31	Full Moon
Jan. 14	01:00	Moon 8.4 Degrees SSW of Mars
Jan. 16	09:08	Last Quarter
Jan. 17	17:00	Moon 6.1 Degrees S of Saturn
Jan. 17	21:29	Moon at Perigee (369,882 km – 229,834 miles)
Jan. 20	02:12	Extreme South Declination
Jan. 21	13:00	Moon 1.8 Degrees SSE of Pluto
Jan. 22	11:00	Moon 4.7 Degrees NNW of Mercury
Jan. 23	07:41	New Moon (Start of Lunation 1102)
Jan. 25	07:00	Moon 5.5 Degrees NNW of Neptune
Jan. 26	14:00	Moon 6.3 Degrees NNW of Venus
Jan. 27	23:00	Moon 5.5 Degrees NNW of Uranus
Jan. 30	12:00	Moon 4.4 Degrees NNW of Jupiter
Jan. 30	17:43	Moon at Apogee (404,324 km – 251,235 miles)
Jan. 31	04:11	First Quarter
Feb. 03	07:12	Extreme North Declination
Feb. 07	21:55	Full Moon
Feb. 10	04:00	Moon 9.0 Degrees SSW of Mars
Feb. 11	18:33	Moon at Perigee (367,919 km – 228,614 miles)
Feb. 12	22:00	Moon 6.0 Degrees SSW of Saturn
Feb. 14	17:05	Last Quarter
Feb. 16	08:36	Extreme South Declination
Feb. 17	22:00	Moon 1.7 Degrees SSE of Pluto
Feb. 21	20:00	Moon 5.5 Degrees NNW of Neptune
Feb. 21	22:36	New Moon (Start of Lunation 1103)
Feb. 23	01:00	Moon 5.6 Degrees NNW of Mercury
Feb. 24	08:00	Moon 5.3 Degrees NNW of Uranus
Feb. 25	21:00	Moon 3.2 Degrees N of Venus
Feb. 27	03:00	Moon 3.8 Degrees NNW of Jupiter
Feb. 27	14:03	Moon at Apogee (404,862 km – 251,570 miles)
Mar. 01	01:22	First Quarter
Mar. 01	16:12	Extreme North Declination
Mar. 07	24:00	Moon 9.1 Degrees SSW of Mars
Mar. 08	09:41	Full Moon
Mar. 10	10:03	Moon at Perigee (362,399 km – 225,184 miles)
Mar. 11	03:00	Moon 5.9 Degrees SSW of Saturn
Mar. 14	14:12	Extreme South Declination
Mar. 15	01:26	Last Quarter
Mar. 16	02:00	Moon 1.4 Degrees SSW of Pluto
Mar. 20	02:00	Moon 5.6 Degrees NNW of Neptune
Mar. 22	12:00	Moon 1.4 Degrees NNW of Mercury
Mar. 22	12:00	New Moon (Start of Lunation 1104)
Mar. 22	20:00	Moon 5.2 Degrees NNW of Uranus
Mar. 25	23:00	Moon 3.0 Degrees N of Jupiter
Mar. 26	06:05	Moon at Apogee (405,779 km – 252,139 miles)
Mar. 26	21:00	Moon 2.0 Degrees SSE of Venus
Mar. 28	23:42	Extreme North Declination
Mar. 30	19:41	First Quarter

Table courtesy of William Dembowski

Lunar Meteoritic Impacts

Brian Cudnik,
Program Coordinator
cudnik@sbcglobal.net

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

Lunar Transient Phenomena

Dr. Anthony Cook,
Program Coordinator
tony.cook@alpo-astronomy.org

Twitter LTP alerts are now available at *http://twitter.com/lunarnaut*.

Finally, please visit the ALPO Lunar Transient Phenomena site online at *http://alpo-astronomy.org/lunar/ltp.html*.

Mars Section

Roger Venable,
Section Coordinator
rjvmd@hughes.net

Mars has crept westward in the morning sky so that now it is being studied by those who stay up late, not just those who get out of bed early. Quadrature was on December 2nd, and opposition will be on March 3rd. For more information on the current apparition, see the article, "The Current Apparition of Mars: 2011-2012," in the Summer 2011 issue of this journal (Vol. 53, No. 3.)

Observations began in July and August with some controversy concerning the possible presence of dust clouds obscuring part of the surface (Figure 1.) The controversy is understandable, in that Mars was only 4.4 arc seconds in apparent diameter on these dates.

The season on Mars was late southern summer, a time when large dust storms frequently occur. Although some observers are convinced that Earth-based images showed dust clouds, most remain unconvinced, citing the small apparent size of the planet as a confounding factor. However, an August 4th

Inside the ALPO
Member, section and activity news

composite image by the Mars Reconnaissance Orbiter showed unequivocally that western Hellas contained a regional dust cloud on that date. The images shown here are very good for such a tiny target, and attest to the skill of Jim and Paul in planetary imaging. South is up and planetary east is to the left in all of the images of this article.

By now, the North Polar Hood (NPH) has broken up and the North Polar Cap (NPC) is broad and bright. In addition to the clouds associated with the NPH, a number of orographic clouds, morning limb hazes, and thin clouds at far southern latitudes have been detected. Watch for the regression of the NPC during the first half of 2012. Figure 2 shows two of the finer images of the many that have been received so far.

Send your images, drawings, and descriptions directly to me at *rjvmd@hughes.net*, or post them on the Yahoo list at *tech.groups.yahoo.com/group/marsobservers.* New observers are always welcome.

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

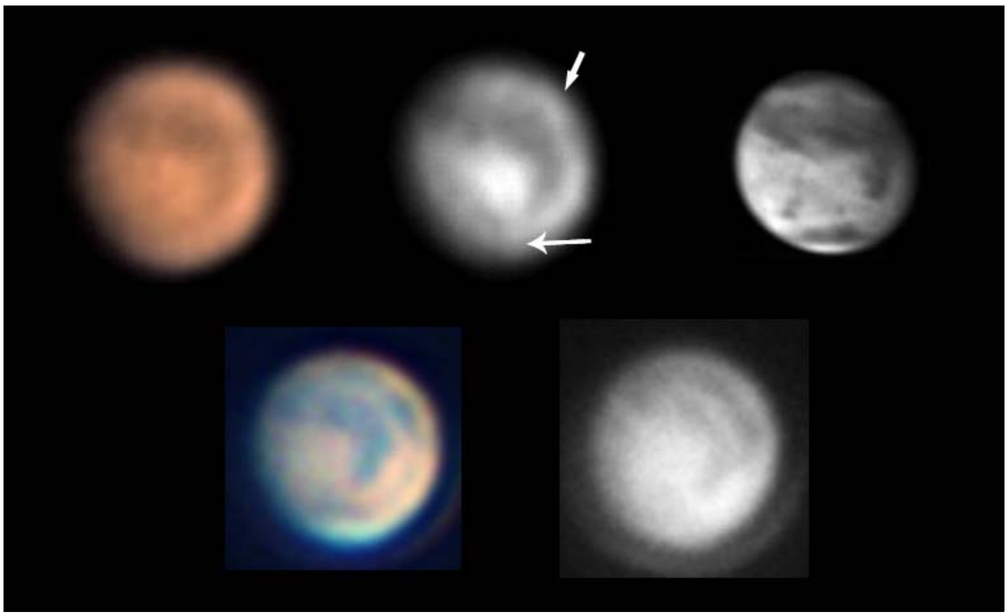


Figure 1. These images by Jim Melka and Paul Maxson from August 4, 5 and 6, 2011, generated controversy. *Top row images* are by Jim Melka. The left one is his Bayer color image of August 4, while the middle one is a red-filtered image of about the same time. The right one is also by Jim, taken during a previous apparition, and used here for comparison. The upper arrow in the middle image points to a bright feature over western Hellas, Mare Serpentis, and Sinus Sabeaus. Note how much brighter this area is than on the comparison image on the right. The lower arrow points to the usual location of dark Umbra and Utopia, which is seen to be very bright compared to the reference image. Note that the illumination of Jim's August 4 image is different from that of the reference image — the former has the limb on the right and the terminator on the left, while the latter has the limb on the left and the terminator on the right. Some critics attributed the findings to "ringing" due to enhancing contrast at the bright limb during processing. *Bottom row images* are by Paul Maxson. The left one an RGB image taken on August 5 and the right one a red-light image taken on August 6. These appear to show progressive movement of a dust cloud across Iapygia and into Syrtis Major, while Umbra appears of varying brightness. The moving obscuration that is bright in red light appears to meet the usual definition of a dust cloud. However, some critics attributed this, too, to the ringing phenomenon. *Image details.* Upper left and upper middle: Taken August 4, 2011, circa 11:00 UT, with 45 cm Newtonian and DBK 21AF04.AS camera with Bayer color (left,) and red filter (middle,) and UV and IR block; S4/10, T4/6; CM = 257°. Upper right: Taken February 3, 2008, at 02:35 UT, with 30 cm Newtonian and DBK 21AF04.AS camera with red filter and UV and IR block; S8/10, T6/6; CM = 260°. Lower left: Taken August 5, 2011, at 12:48 UT, with 25 cm Dall-Kirkham and Flea3 camera, a composite of red, green, and blue images; CM = 273°. Lower right: Taken August 6, 2011, at 12:44 UT, using same equipment as at lower left, but a red filter only; CM = 262°.

Minor Planets Section

Frederick Pilcher,
Section Coordinator
pilcher@ic.edu

Brian Warner, Robert Stephens, and Alan Harris, after much hard work, have established a repository for lightcurves, analogous to that for astrometric measures, at the Minor Planet Center of the Smithsonian Astrophysical Observatory. To date nearly a million photometric data points have been archived, with the number increasing steadily.

Minor Planet Bulletin Vol. 38, No. 3, 2011 July-September, has published graphs of reduced magnitudes (corrected for changing Earth and Sun distances) versus phase angle for asteroids 158, 535, and 1342. These provide the most reliable values of the absolute magnitude H and phase function G ever obtained for these asteroids. Three new very long period rotators were announced: 846 Lipperta, 1641 hours; 1663 van den Bos, 740 hours; and 27810 Daveturner, 540 hours.

Lightcurves with derived rotation periods are published for 87 other asteroids, numbers 28, 33, 81, 126, 150, 161, 280, 283, 321, 334, 419, 434, 632, 862, 890, 902, 919, 933, 938, 948, 1019, 1080, 1177, 1318, 1383, 2035, 2047, 2120, 2650, 2715, 2802, 2869, 3152, 3237, 3252, 3266, 3388, 3447, 3511, 3577, 4175, 4290, 4452, 4464,

Inside the ALPO
Member, section and activity news

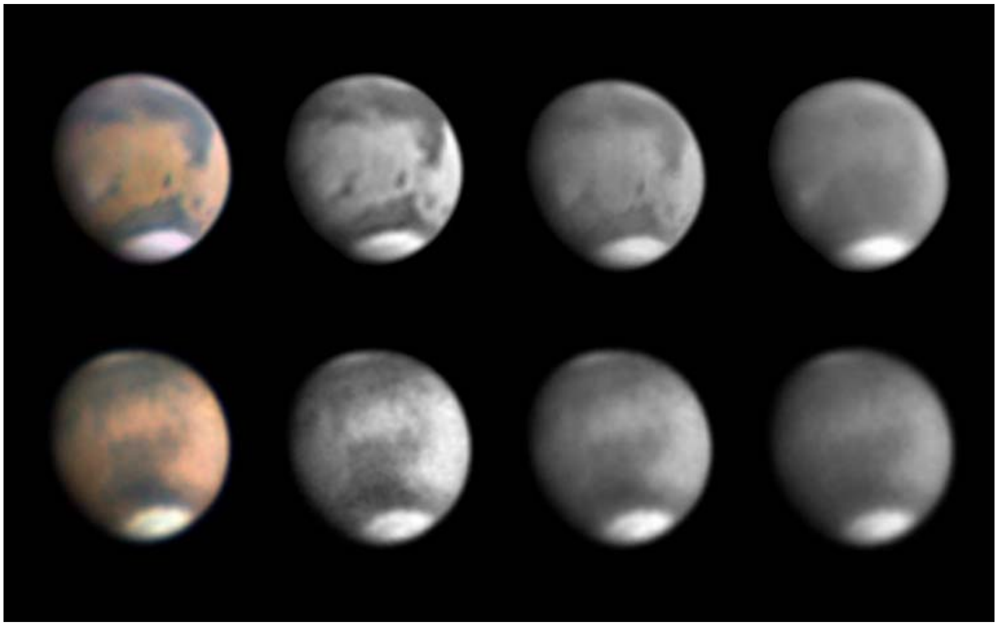


Figure 2. Two fine images taken during the present apparition. *Upper image*. RGB composite image and its component red, green, and blue images (left to right) taken by Damian Peach on November 18, 2011, circa 06:22 UT, using a 35 cm Schmidt-Caesarean and Luminera-brand camera with filters. CM = 242°. Notice the brightness of Elysium (below center at the left.) Notice also that this bright area is adjacent to the Hybleus Extension in red and green, but in blue there is a slight gap between it and the Hybleus Extension. Thus, the red and green images show ground frost in western Elysium, while the blue image shows clouds around Elysium Mons in eastern (left) Elysium. *Lower image*. RGB composite image and its component red, green, and blue images (left to right) taken by John Boudreau on December 13, 2011, at 08:18 UT, using a 28 cm Schmidt-Cassegrain and Flea3 camera with filters. CM = 32°.

4490, 4970, 5168, 6384, 6493, 6577, 6619, 7187, 7579, 7781, 9190, 9233, 9549, 10779, 12265, 12466, 13578, 13822, 14790, 15154, 16562, 16694, 17939, 19131, 20936, 21056, 22696, 23336, 23766, 31485, 32505, 42612, 46784, 48470, 52266, 61461, 65739, 89550, 101771, 113567, 137605, 2001 GU8, 2010 JL33.

Some of these provide secure period determinations, some only tentative ones. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previous period determinations which may be consistent or inconsistent with the earlier values.

Minor Planets Section Coordinator Frederick Pilcher delivered the keynote address at the 2011 ALPO convention on the top "How Amateurs Have Contributed to Asteroid Research." The text of this presentation and all the images are available for download at the ALPO website.

Minor Planet Bulletin Vol. 38, No. 2, 2011 April - June, contains lightcurves and rotation periods for 13 additional Trojan asteroids found by Linda French, Robert Stephens, and colleagues. A binned graph of rotation periods for 40 Trojan asteroids larger than 70 kilometers, most of those in that size range, is presented.

The *Minor Planet Bulletin* is a refereed publication and that it is available online at http://www.minorplanet.info/mpb-downloads.html. Annual voluntary contributions of $5 or more in support of the publication are welcome.

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

Jupiter Section

Richard W. Schmude, Jr., Section Coordinator
schmude@gdn.edu

Jupiter is well-placed for evening observation during January and February. Both of the equatorial belts are dark. Jupiter is also a few percent brighter than expected.

The 2009-2010 Jupiter report was published in JALPO53-4 (Autumn 2011). The 2010-2011 report is scheduled for publication in either the spring or summer issue of this Journal.

At least 60 people have submitted images or other observations of Jupiter during the current apparition. I am planning to start working on the 2011-2012 Jupiter apparition report in the spring of 2012.

One other plan that I have is that I would like to learn how to use the program "winjupos". My goal is to measure the shape and size of Jupiter's white oval storms. It will be interesting to see how these storms develop from one year to the next.

Please continue making images of Jupiter. I am also interested in methane band images and visual intensity estimates.

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

Inside the ALPO
Member, section and activity news

If you have not yet submitted your timings of the eclipses of the Galilean satellites for the past apparition (2010-2011), we would be happy to receive them. We have placed on the ALPO Jupiter Section webpage a schedule of satellite eclipses for the 2011-2012 Apparition of Jupiter.

As stated in the previous report for this ALPO observing section, three circumstances have come together to allow us to view something we see only rarely – both the beginnings and endings of the same eclipses of Europa. For the great majority of the time, we can see only disappearances of the satellite before opposition, and only reappearances after opposition (indeed, some literature incorrectly states that this is always the case).

The first condition that helps create this series of events is that Jupiter is closer than average to the Sun, having reached perihelion on 2011 March 17 (4.9494 AU from the Sun). The second situation is that the Earth is well north of Jupiter's equator (and thus the orbital planes of the Galilean satellites; 3.89° north on 2011 October 01). Finally, the Sun also is north of the Jupiter's equator (3.57° north on 2012 March 10). This allows us to peek past the planet and, before opposition see both eclipse disappearances and reappearances; the last very close to Jupiter's limb. After opposition, we have the opposite, with the disappearances next to Jupiter's limb and the reappearances well away from the planet.

Due to the lateness of this Journal, there 28 remaining occurrences when we will be able to see these complete (beginning and ending) eclipses of Europa: 2012 January 16 - February 17; and 2012 August 06 - Oct 05.

Table Completely Visible Eclipses of Europa by Jupiter, 2012

Series 2 (10 eclipses)			Series 3 (18 eclipses)		
TT Date	Begin	End	TT Date	Begin	End
Jan 16	hh mm 17 02	hh mm 19 29	Aug 06	hh mm 07 28	hh mm 09 51
Jan 20	06 23	08 49	Aug 09	20 45	23 08
Jan 23	19 42	22 08	Aug 13	10 02	12 25
Jan 27	09 02	11 28	Aug 16-17	23 19	01 42
Jan 30-31	22 21	00 47	Aug 20	12 36	14 59
Feb 03	11 41	14 07	Aug 24	01 53	04 16
Feb 07	01 00	03 26	Aug 27	15 10	17 33
Feb 10	14 20	16 46	Aug 31	04 27	06 50
Feb 14	03 39	06 04	Sep 03	17 44	20 07
Feb 17	16 59	19 24	Sep 07	07 01	09 24
			Sep 10	20 18	22 41
			Sep 14	09 35	11 58
			Sep 17-18	22 52	01 15
			Sep 21	12 09	14 32
			Sep 25	01 26	03 49
-	-	-	Sep 28	14 43	17 06
-	-	-	Oct 02	04 00	06 24
-	-	-	Oct 05	17 18	19 41

We hope that some of our readers will watch and time some of these events. (Normally, we must time Europa's eclipse reappearances months after we time its disappearances.) The table that accompanies this report gives the dates and terrestrial times (TT) of these events. (Subtract about one minute to convert TT to UT.)

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, also available on the Jupiter Section page of the ALPO website.

Saturn Section

Julius Benton,
Section Coordinator
jlbaina@msn.com

Saturn presently appears at apparent visual magnitude +0.7, rising in the eastern sky during the early morning hours and attains sufficient altitude prior to sunrise for worthwhile viewing. The planet's northern hemisphere and north face of the rings are now visible as the ring tilt toward Earth increases throughout the next several years, with regions south of the rings becoming progressively less favorable to view. Right now the rings are inclined about +15.0 toward Earth. The table of geocentric phenomena for the 2011-12 apparition is presented for the convenience of readers who wish to plan their Saturn observing activities.

As of this writing, observers have already been submitting images of the planet as it gradually becomes more favorable for study. The most notable highlight during the previous observing season was the emergence of a massive storm in the region of Saturn's North Tropical Zone (NTrZ), first detected by ALPO observers in early December 2010, and was regularly observed and imaged ever since as the brightest feature seen on the planet in recent years. The NTrZ white "complex" exhibited considerable brightening over time, undergoing rapid evolution and differentiation into bright and dusky structures along its length. The storm progressively widened in latitude and underwent considerable longitudinal growth, eventually encircling the globe. Cassini images also dramatically showed how the storm rapidly

Inside the ALPO
Member, section and activity news

evolved with time. Observations just received by ALPO observers at the beginning of the current apparition clearly show the morphologically complex remnants of the enormous storm, still apparently encircling the globe at the latitude of the NTrZ. It will be interesting to continue to follow the appearance of this feature throughout the 2011-12, watching for and documenting any changes or outbursts in the region.

As the inclination of Saturn's northern hemisphere toward the Sun increases, with subsequently greater solar insolation affecting these regions, conditions continue to be favorable for activity to develop similar to the NTrZ white storm. Color filter techniques can be used by visual observers to determine which visual wavelengths produce the best views of the NTrZ storm and other similar features that might emerge, and consistent digital imaging at visual, infrared, UV, and methane (CH_4) wavelength bands is particularly important.

The observation programs conducted by the ALPO Saturn Section are listed on the Saturn page of the ALPO website at *http://www.alpo-astronomy.org/* as well as in considerable detail in the author's book, *Saturn and How to Observe It*, available from Springer, Amazon.com, etc., or by writing to the ALPO Saturn Section for further information. Observers are urged to carry out digital imaging of Saturn at the same time that others are imaging or visually watching Saturn (i.e., simultaneous observations). Although regular imaging of Saturn is extremely important and highly encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time. So, this type of visual work is strongly encouraged before or after imaging the planet.

The ALPO Saturn Section appreciates the dedicated work by so many observers who regularly submit their reports and images. *Cassini* mission scientists, as well as other professional specialists, are continuing to request drawings, digital images, and supporting data from amateur observers around the globe in an active Pro-Am cooperative effort.

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn pages on the official ALPO Website at *www.alpo-astronomy.org/saturn*.

All are invited to also subscribe to the Saturn e-mail discussion group at *Saturn-ALPO@yahoogroups.com*

Table Geocentric Phenomena for the 2011-2012 Apparition of Saturn in Universal Time (UT)	
Conjunction	2011 Oct 13^d
Opposition	2012 Apr 15^d
Conjunction	2012 Oct 25^d
Opposition Data:	
Equatorial Diameter Globe	19.0 arc-seconds
Polar Diameter Globe	16.9 arc-seconds
Major Axis of Rings	43.0 arc-seconds
Minor Axis of Rings	28.6 arc-seconds
Visual Magnitude (m_v)	0.2 m_v (in Virgo)
B =	+13.7º

Recent digital image showing the appearance of the massive, evolving NTrZ storm complex discovered in 2011 as it continues to encircle the globe of Saturn. Image was taken on January 1, 2012 at 06:15UT by Jim Phillips of Charleston, SC, using a 25.4 cm (10.0 in.) refractor in visible light (RGB) in fair seeing. Apparent diameter of Saturn's globe is 16.6 arc seconds with a ring tilt of +14.8º. CMI = 207.7°, CMII = 4.0°, CMIII = 52.1°. South is at the top of the image.

Remote Planets Section

Richard W. Schmude, Jr., Section Coordinator
schmude@gdn.edu

Both Uranus and Neptune will reach conjunction in early 2012. Uranus will be visible in the early evening in January and early February, but will be too close to the Sun after about February 14. Neptune will be difficult to observe during the first three months of 2012.

Several people have submitted high-quality observations of both planets during 2011. Jim Fox has submitted almost 20 high-quality brightness measurements of Neptune. This writer has made 12 brightness measurements of the planet Uranus. My measurements in early December indicate that Uranus was brighter in the infrared than what it was in October. This brightening may be due to the bright spot imaged by professional astronomers in late October.

The 2010-2011 Remote Planets report appears later in this Journal. I am planning to write the 2011-2012 Remote planets report sometime during the middle of 2012. In the meantime, please send me any observations of the remote planets as soon as possible.

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

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

Feature Story: Venus

Clouds and Chimeras, Self-Deception and Serendipity

Tom Dobbins, assistant coordinator, ALPO History Section
tomdobbins@gmail.com

Scientific fraud is comparatively rare. A few "bad apples" do betray the lofty ideals of the profession. Motivated by careerism, prestige, money, or ideology, the perpetrators succumb to the temptation to tidy up experimental data, fudge statistics, and, in the most extreme cases, invent experiments or observations out of thin air. Such deceit can go undetected for months, years, or, in a few rare instances, even centuries.[1] But on the whole, the scientific enterprise is an objective, self-correcting search for truth.

In science, self-deception is a problem of far more pervasive importance than outright fraud. Even the most rigorous training in objective observation confers no immunity from the desire to obtain a particular result. Conclusions can be unconsciously shaped in many subtle ways. Nor is self-deception a phenomenon that affects only individuals. Sometimes a whole community of investigators can share a common delusion.

Figure 1: Gerard Kuiper.

There are few fields of scientific endeavor in which the human factor proved more intractable than the telescopic study of the planets. Gerard Kuiper (1905-1973), one of the leading lights of planetary science during the tumultuous generation that witnessed spacecraft replace telescopes as the principal instrument of planetary exploration, stressed that the planetary observer "should be totally disinterested in the outcome of his observation" and "divorce himself of all wishes, emotions, and recollections, and become an 'instrument' until the work is completed."[2]. Of course, no such observer has ever existed.

During the long history of Earthbound planetary astronomy, no celestial object was the subject of more pervasive and persistent self-deception than our nearest planetary neighbor, Venus. By far the most beautiful of all the planets to the naked eye, at its brightest, Venus shines thirteen times brighter than Sirius, the brightest of all the fixed stars, and five times brighter than planet Jupiter. When there is no moonlight to interfere, Venus can cast shadows that are readily perceptible, especially when they fall on snow-covered ground. In a deep blue, transparent sky, Venus can even be spotted in broad daylight, particularly if the observer stands in a shaded place, such as a narrow street flanked by high buildings.

Soon after the invention of the telescope, astronomers came to regard Venus as the Earth's "twin sister" because the two worlds are so similar in size and mass. Yet for all its brilliant splendor, Venus is a bitter disappointment for telescopic observers. Apart from displaying a characteristic array of Moon-like phases, the planet offers only a dazzling, monotonous cloudscape. As the Mariner 2 spacecraft approached Venus in 1962 on the first close-up reconnaissance mission to another planet, rocket designer and space visionary Krafft Ehricke (1917-1984) opined that "Venus might hold even more surprises than Mars." How right he was.

All Readers

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

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).

The armada of spacecraft that followed Mariner 2 revealed that this unbroken overcast is much higher and thicker than any cloudbank on Earth, extending from 45 kilometers (27.9 miles) above the planet's surface up to 70 kilometers (43.5 miles), with tenuous hazes present even at an altitude of 90 kilometers (55.9 miles). These bright clouds are composed of aerosols of corrosive sulfuric acid droplets mixed with unidentified particulates that may be elemental sulfur, the chlorides of iron or aluminum, or oxides of phosphorous. Beneath the cloud canopy, the atmosphere of Venus increases in density until at the surface it exerts crushing pressures equal to those at a depth of half-mile beneath the sea. Here, hellish temperatures hot enough to melt lead, tin and zinc prevail.

Through a telescope, only evanescent shadings of low contrast can be glimpsed in the uppermost layers of the atmosphere of Venus, which alone are accessible to our sight. Not

Figure.2: William Frederick Denning.

surprisingly, few observers were enticed into making a protracted study of the planet. The greatest observational astronomer of the 18th century, Sir William Herschel (1738-1822), observed Venus on many occasions between 1777 and 1793, but never succeeded in discerning anything more than faint spots that "assumed often the appearances of optical deceptions" and were "extremely faint and changeable."[3] Herschel's contemporary, the German astronomer Johann Hieronymous Schroeter (1745-1816), observed Venus at every opportunity for nine years before he was able to detect a definite marking, and that was only a "filmy streak."[4] Even the "eagle-eyed" William Rutter Dawes (1799-1868), who was renowned for his remarkable visual acuity, always found the planet devoid of markings. Based on this barren record, in 1852, William Herschel's son Sir John Herschel (1792-1871) complained that Venus was the most difficult of all the planets to observe:

> "The intense luster of its illuminated part dazzles the sight and exaggerates every imperfection of the telescope, yet we see clearly that its surface is not mottled over with permanent spots like the Moon; we notice in it neither mountains nor shadows, but a uniform brightness In which we may indeed fancy, or perhaps more than fancy, brighter or obscurer portions, but can never rest fully satisfied of the fact."[5]

Venus proved especially disappointing through large telescopes, which often showed less detail than seemingly far less powerful instruments. At any given magnification, doubling the aperture of a telescope will increase the apparent brightness of a planet by a factor of four. However, low-contrast markings on a uniform background are best discerned under moderate levels of illumination, an attribute of human perception that psychologists call the "Weber-Fechner law." Reducing the intense brightness of the image of Venus can reveal features that would otherwise go undetected, but finding the optimum magnification is a delicate balancing act.[6] The director of the British Astronomical Association's Mercury and Venus Section, Hedley Robinson (1935-2007), cautioned prospective observers of Venus that "one can use too little magnification in the telescope and so render the image too bright to see detail, but too much magnification will kill the contrast and again render the delicate shadings invisible."[7]

The comparative freedom from glare afforded by small apertures was no panacea, however. As in ethics, virtue seemed to consist of a mean between the extremes of very large and very small telescopes. William Frederick Denning (1848-1931), one of the most accomplished British amateur astronomers of the Victorian era, cautioned:

> Accounts are sometimes published of very dark and definite markings seen with only 2 or 3 inches aperture. Such assertions are usually unreliable. Could the authors of such statements survey the planet through a good 10- or 12-inch telescope, they would see at once that they had been deceived. Some years ago I made a number of observations of Venus with 2-, 3- and 4.2-inch refractors and 4- and 10-inch reflectors, and could readily detect with the small instruments what certainly appeared to be spots of a pronounced nature, but on appealing to the 10-inch reflector, in which the view was immensely improved, the spots quite disappeared, and there remained scarcely more than a suspicion of the faint condensations which usually constitute the only visible markings on the surface.[8]

Simultaneous drawings of Venus by different observers often recorded bewilderingly incongruous markings, leading to a widespread attitude that they should all be taken with a few grains of salt. During the 1950s, one of the British Astronomical Association's veteran planetary

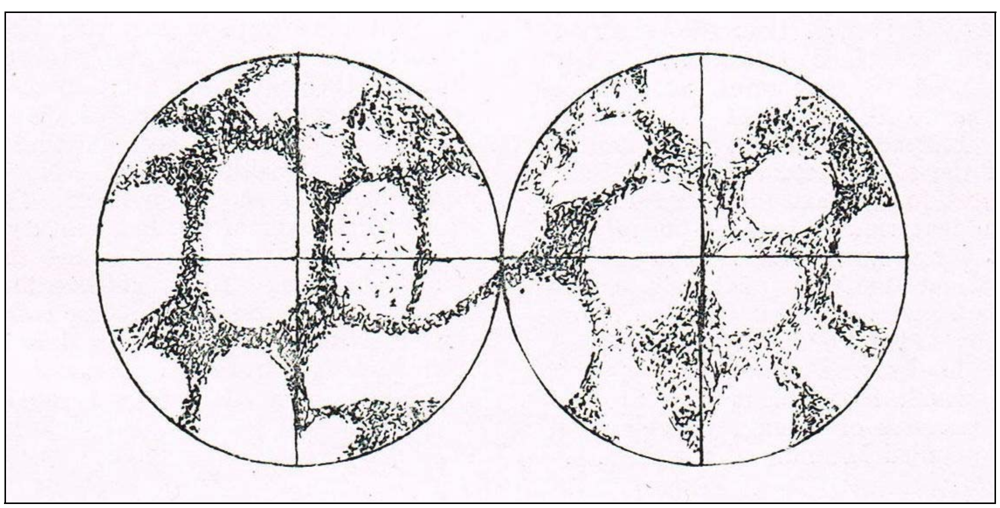


Figure 3: The map of spurious permanent features on Venus based on observations by Stuyvaert and Niesten.

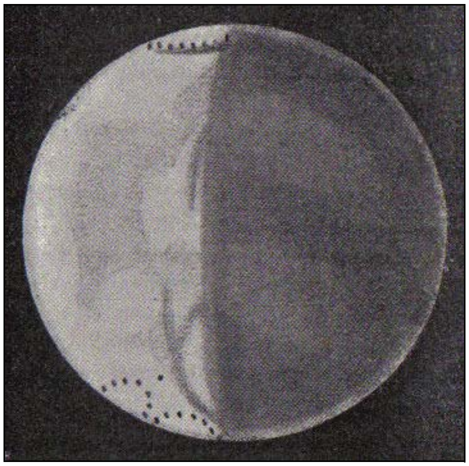


Figure 4: A drawing of Venus by Leo Brenner depicts markings that he mistook for oceans and continents glimpsed through clearings in the clouds.

observers told the neophyte Alan Heath that he admired his drawings of Venus. "But I hardly ever see anything," Heath quizzically replied. "Precisely my point," was the rejoinder.

With its surface so effectively concealed from prying eyes, the axial rotation period of Venus remained one of astronomy's most uncertain parameters for centuries. Even at the dawn of the Space Age, the length of a day on Venus was still an almost embarrassing unknown that was often indicated with a question mark in textbooks.

The majority of observers favored an Earth-like rotation period. As early as 1667, Giovanni Domenico Cassini (1625-1712) announced a period of 23 hours 21 minutes. This value was confirmed by Schroeter in 1793. Following a two-year study, in 1841, the Jesuit astronomer Francesco de Vico (1805-1848) and his assistants at the Vatican Observatory managed to add just 22 seconds to Cassini's value. After nine years of observations at the Royal Observatory in Brussels, the Belgian astronomers Louis Niesten (1844-1920) and Charles-Émile Stuyvaert (1851-1908) endorsed the results of their Italian predecessors and even drew up a peculiar map of the planet's ephemeral markings. The quixotic Serbian astronomer Leo Brenner (1855-1928?), who imagined that he could glimpse oceans and coastlines through transient clearings in the cloud deck, offered a pedantically precise value of 23 hours 57 minutes 36.2396 seconds, a feat not too unlike a geologist determining the age of the Earth to the nearest minute.[9]

Despite what seemed to be a decent measure of agreement, these results failed to inspire a great deal of confidence, chiefly because they were difficult to reconcile with the fact that painstaking micrometer measurements had failed to detect the perceptible *oblateness* (polar flattening) that would result if Venus were really spinning so rapidly on its axis. (Measured from pole to pole, the Earth's diameter is 42 kilometers (26 miles) shorter than its diameter at the equator.)

In 1877, the year that he made the dramatic announcement of the presence of *canali* ("channels") on Mars, Giovanni Schiaparelli (1835-1910), the Director of the Brera Observatory in Milan, had turned his attentions to Venus. The observatory's 8.6-inch refractor was modest in size, but unsurpassed in optical and mechanical quality, a masterpiece made by the renowned Munich firm of Georg Merz (1793-1867). Rather than observing Venus at a modest elevation above the horizon during brief intervals in morning or evening twilight, Schiaparelli used the setting circles of the instrument's equatorial mount to flush his quarry from its hiding place high in the midday sky. The brilliance of Venus more than compensated for the veiling background luminance of the sky, and the reduced glare made the planet's delicate features stand out more prominently. Of paramount importance, Schiaparelli was able to keep Venus under continuous surveillance during observing sessions lasting many hours.

There was precious little to see, but day after day from November of 1877 to February of 1878, Schiaparelli managed to make out a dusky, shading parallel to the *min*, the boundary dividing the dark and sunlit portions of the disk, and diffuse bright oval spots near each of the horns or cusps of the crescent. The latter features had first been described in 1813 by the Bavarian astronomer Franz von Paula Gruithuisen (1774-1852), who thought they were polar snow caps despite their frequent variations in size, shape, and prominence.[10]

Although Schiaparelli was able to scrutinize these markings for up to eight hours at a time, they never exhibited the slightest motion relative to the terminator during his vigils. Dismissing the results of his predecessors, which he attributed to eyestrain and the power of suggestion, Schiaparelli in 1890 cited this lack of motion as evidence that Venus has a very slow "captured" rotation period of 225 terrestrial days, turning on its axis in the same interval that it takes to complete an orbit around the Sun.[11] If this were true, the sunward face of the planet would be bathed in perpetual sunlight, while the opposite side would be shrouded in endless night.

The prior year, Schiaparelli had announced that after eight years of observations, he had determined that Mercury turns but once on its axis once during each orbit of the Sun, a claim that was not only uncritically accepted but widely acclaimed. Indeed, there were sound theoretical reasons for doing so. In 1877, George Howard Darwin (1845-1912), the son of the famous naturalist, had published an exhaustive mathematical study demonstrating that the tides raised by

Figure 5: Giovanni Schiaparelli.

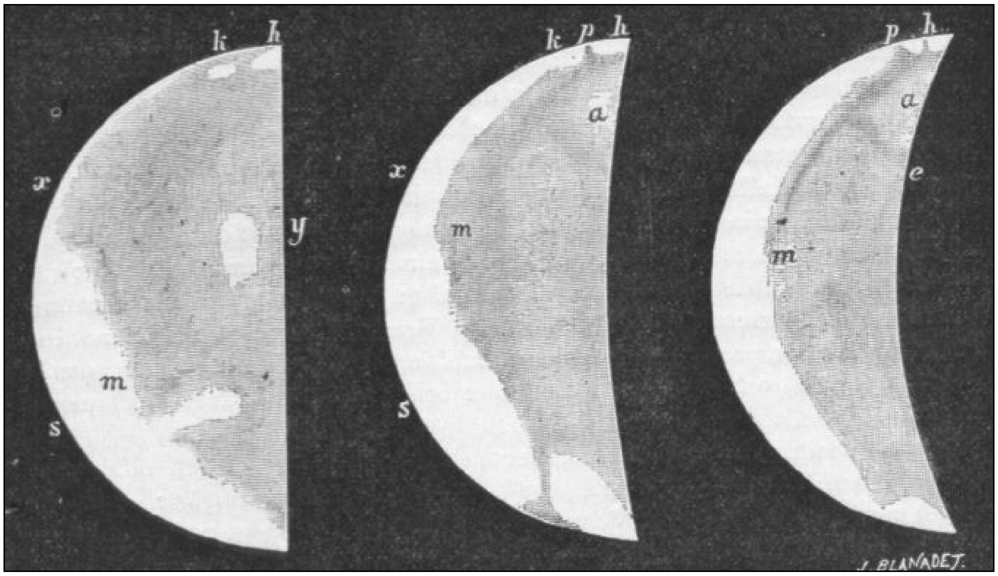


Figure 6: These sketches of Venus by Schiaparelli record features near the southern (upper) cusp of the crescent (denoted as k, p, and h) whose immobility from day to day led him to believe that the planet's axial rotation period and orbital period were identical.

the Earth on the primordial molten Moon had gradually slowed our satellite's spin until it turned on its axis in the same period that it takes to complete one circuit around the Earth. Darwin coined the terms "tidal friction" and "captured rotation" to describe this mechanism and its consequence. Indeed, as early as 1865 the American mathematician Daniel Kirkwood (1814-1895) had speculated that the immense tides raised by the nearby Sun ought to have braked Mercury's rotation until it became equal to its year of 88 terrestrial days.

Many of the astronomers who had not hesitated to embrace Schiaparelli's synchronous rotation period for Mercury were reluctant to accept his claims about the rotation of Venus. After all, the tidal pull that the Sun exerts on Venus is not nearly as strong as its influence on Mercury, and the Earth, which rotates fairly rapidly, is not too much farther from the Sun than Venus. If Venus does keep one hemisphere constantly facing the Sun, the doubters argued, it would be a world of harsh extremes. The dense, cloud-laden atmosphere should have frozen out long ago on its frigid nighttime hemisphere. Schiaparelli's suggestion that violent winds blowing steadily from the sunward side could moderate extremes of temperature around the entire globe and allow the atmosphere to persist just didn't ring true.

The immobility of the bright patches on Venus observed by Schiaparelli did suggest another possibility, however. An experiment conducted at the Munich Observatory in 1897 by the Swiss astronomer Walter Villiger (1872-1938) using "artificial planets" cast grave doubts on the reality of the features depicted in Schiaparelli's numerous drawings of Venus.[12] Villiger placed 2-inch diameter balls 400 meters (137.8 feet) away from a 5-inch telescope. Viewed from that distance, the balls had the same apparent size as Venus, and they were illuminated by a spotlight that could be moved to show a sequence of phases. To simulate different surface textures, some of the balls were made of plaster of Paris, while others were smooth rubber that were painted matte white.

Villiger asked his experimental subjects to take turns at the eyepiece of the telescope and sketch what they saw. These featureless spheres evoked perceptions of the same non-existent markings from the majority of his subjects. The most common spurious features were dusky linear shadings parallel to the terminator, narrow, bright bands adjacent to the limb, and bright cusp caps near the tips of the crescent.[13] Villiger's experiment was a convincing demonstration that even the most skilled observers can fall victim to optical illusions.

Despite the seeds of doubt planted by Villiger's experiment, Schiaparelli was held in very high esteem by his contemporaries and his word carried considerable weight. Corroborating observations of stationary markings on Venus were soon reported by Henri Perrotin (1845-1912) of the Nice Observatory. Perrotin, it should be noted, had been one of the first astronomers to confirm not only Schiaparelli's elaborate canal network on Mars, but also the curious proclivity of some canals to form duplicate parallel twins. This phenomenon, called *gemination* by Schiaparelli, was almost universally regarded as an optical illusion of some sort.

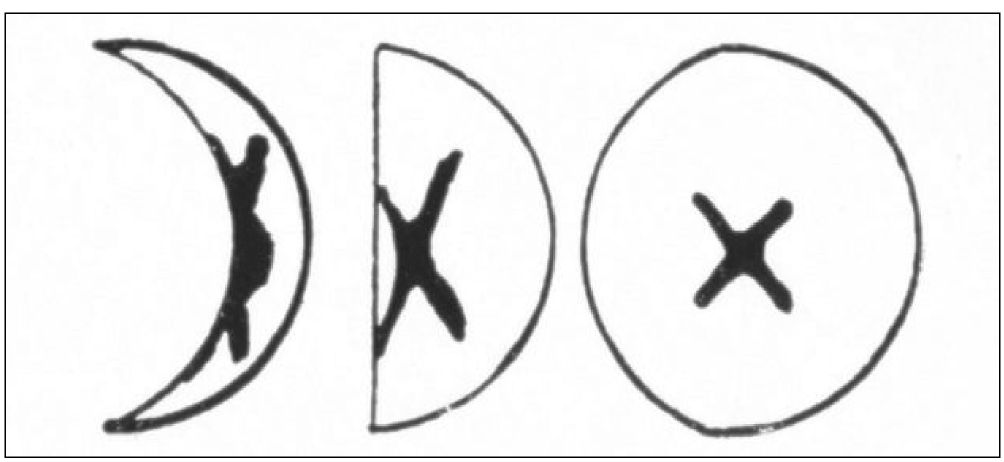


Figure 7: Spurious features recorded by Villiger's experimental subjects when observing featureless spheres through a small telescope.

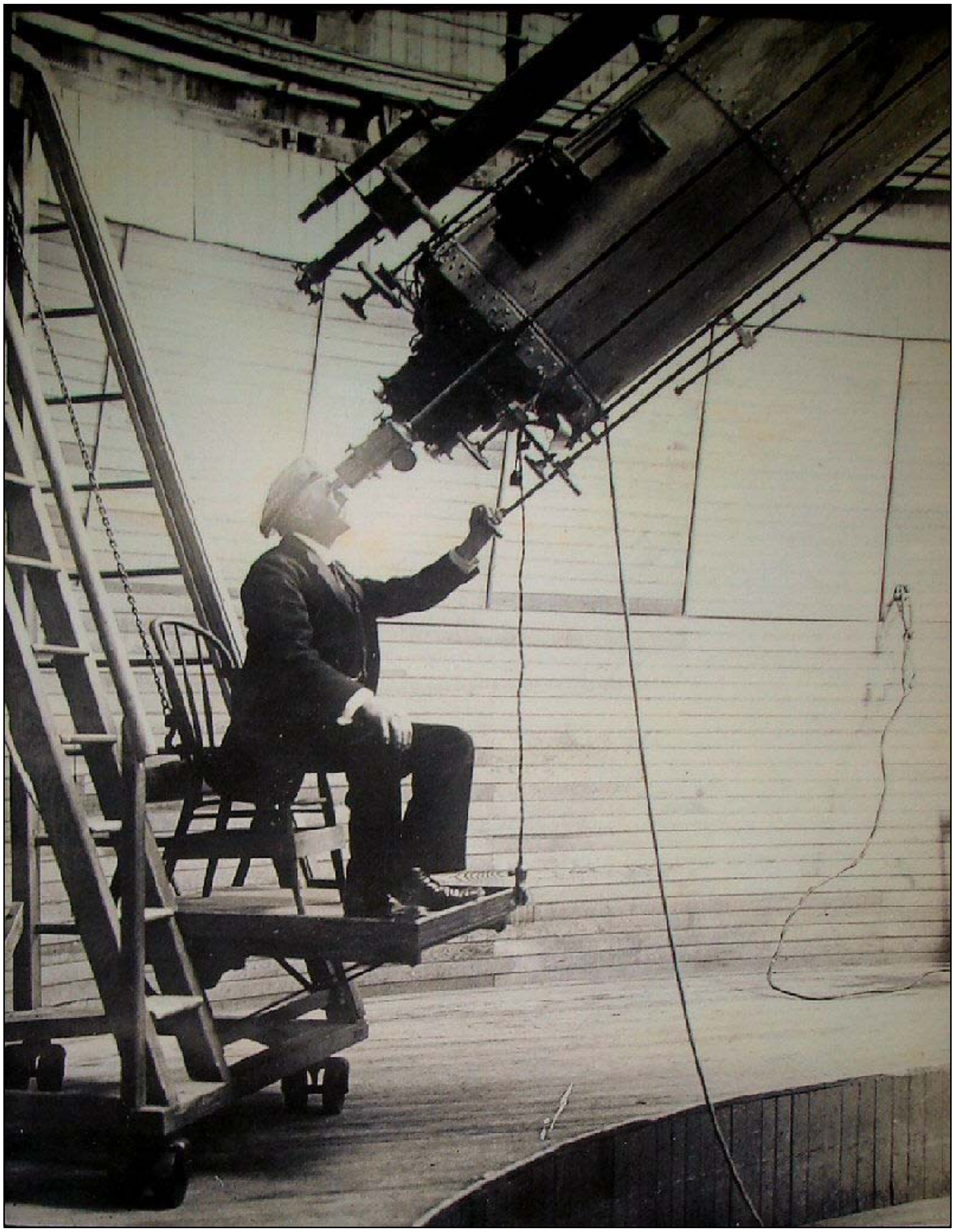


Figure 8: Percival Lowell observing Venus in daylight through the 24-inch Clark refractor.

If anyone was even more eager than Perrotin to confirm Schiaparelli's findings, it was Percival Lowell (1855-1916). Although Lowell will always be best remembered for his studies of Mars, he also made controversial observations of other planets, especially Venus. He followed closely in Schiaparelli's footsteps, elaborating on (some might be tempted to say "embellishing") his work. As Schiaparelli's failing eyesight forced him to abandon observing, Lowell aspired to become the successor of the Italian astronomer he so ardently admired. If expectation were ever the father of illusion, the stage was set.

In the summer of 1896, Lowell had just installed a superb new 24-inch refractor in a dome atop Mars Hill overlooking the town of Flagstaff, Arizona. He had time to kill as he waited for Mars to make its next close approach in December, so on August 21, he had his first look at the small, gibbous disk of Venus in daylight, emulating Schiaparelli's preferred method of observing the planet. Although Venus was riding high in a brilliant late morning sky, he found the image "too bright and badly shattered by air currents" at the modest magnification of 140X. Lowell knew that the smaller the aperture of a telescope, the higher the probability that the light path through the overlying atmosphere will be optically homogenous at any given instant. To reduce the effects of atmospheric turbulence, he reduced the aperture of his telescope using a huge iris diaphragm that he had fitted to the cell of his refractor's objective lens.[14]

During the course of the next few days a confusing array of dusky streaks and spots began to emerge. By early October, they had assumed a form resembling the spokes of a wheel radiating from a central hub. This characteristic pattern, however, could only be seen distinctly when the aperture was stopped down to a diameter of 1.6 to 3 inches.

Lowell and his assistants took turns sketching the planet, but none of their depictions closely resembled Lowell's, except for those of his secretary and mistress, Wrexie Louise Leonard. Far from being discouraged, Lowell claimed that the impressions of a neophyte like Wrexie were compelling evidence that the features were objectively real because an utter novice is a "blank slate" free of preconceived ideas and prejudices.[15]

Rather than soft, nebulous shadings, Lowell claimed that the markings on Venus were "surprisingly distinct; in the matter of contrast, as accentuated in good seeing as the markings of the Moon, and owing to their character much easier to draw; in the matter of contour, perfectly defined throughout, their edges being well marked and their surfaces well differentiated in tone from one another, some being much darker than others."[16] He boldly asserted that these markings were "not only permanent, but permanently visible whenever our own atmospheric conditions are not so poor as to obliterate all detail on the disk."[17]

Rather than transient clearings in the cloud canopy, Lowell imagined that the spokes and nodes were permanent surface features, "rock or sand weathered by eons of exposure to the Sun" seen through the "diaphanous straw-colored veil" of a dense but strangely transparent, cloudless atmosphere. This notion was very difficult to reconcile with the well-established fact that Venus has a singularly high albedo, reflecting about 77% of incident sunlight. This reflectivity was known to be consistent with cumulus or stratus clouds, so accepting Lowell's findings required discarding one of the few attributes of Venus about which there was universal agreement, namely that the planet is substantially covered by a thick blanket of clouds.

Despite Lowell's claim that these markings constituted irrefutable proof of the synchronous rotation period proposed by Schiaparelli, his reports were greeted with almost universal derision and elicited a flurry of caustic remarks. After Lowell's sketches of the planet were displayed at a meeting of the Royal Astronomical Society, the outspoken Captain William Noble (1828-1904) commented: "I do not know whether Mr. Lowell has been looking at Mars until he has got Mars on the brain, and by some transference transcribed the markings to Venus."[18]

One Lowell's most doggedly persistent and effective critics, the Greco-French astronomer Eugène Antoniadi (1870-1944), commented disdainfully that he would refrain from even discussing the Venus discoveries emanating from Lowell Observatory, whose observers, "forgetting Venus is decently clad in a dense atmospheric mantle, cover what they call the 'surface' of the unfortunate planet with the fashionable canal network."[19] He was quick to point out that Lowell always depicted the central hub of the spoke system in the precisely same location regardless of the planet's changing phase, as if Venus always presented the same face to the Earth and not the Sun as Lowell claimed.

Lowell quickly launched a counterattack, employing a tactic that had served him well in arguments with critics of his intricate network of Martian canals. He insisted that it was the unsurpassed tranquility and transparency of the atmosphere over his Arizona observing site, located at an elevation of 7,000 feet, that allowed him to see as "perfectly distinct and unmistakable" planetary markings that had eluded observers who did not enjoy the advantage of his "see-level."

Lowell put on a brave public face but he was plagued by self-doubt. The barrage of criticism soon took its toll and for more than three years he would be sidelined with "neurasthenia," the term used at the end of the 19th century to describe what we would now call depression. He retired to his father's house in Boston for the prescribed "rest

With Lowell out of commission, the task of defending the spoke system fell to Andrew Ellicott Douglass (1867-1962), who was appointed "Assistant Charge" during Lowell's absence. Douglass mounted a spirited defense of his employer, goading critics with jibes like:

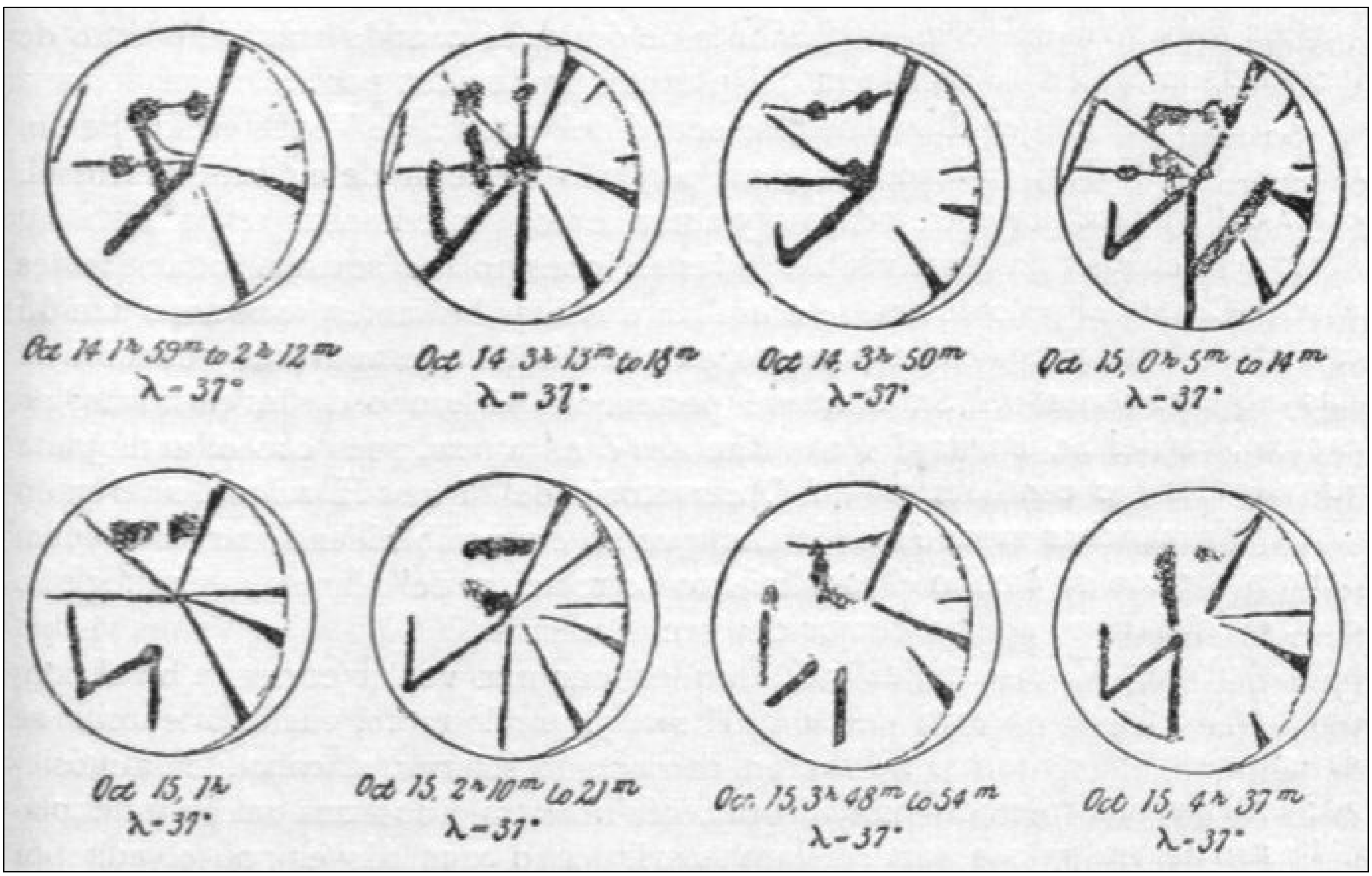


Figure 9: Sketches by Lowell of Venus near superior conjunction in 1896.

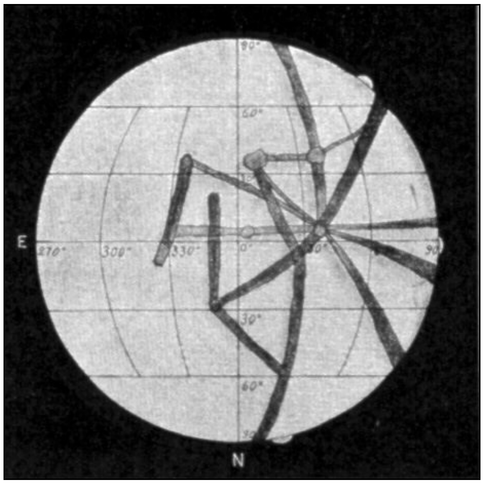


Figure 10: Lowell's chart of the spoke system.

"No one is entitled to cry out against us until he can show that his atmosphere is approximately as good as the one through which Mr. Lowell discovered these markings."[20]

During Lowell's prolonged convalescence and against Lowell's expressed wishes, Douglass quietly began to observe "artificial planets." In a fashion reminiscent of the experiments conducted by Walter Villiger in Germany, he placed small featureless globes nearly a mile from the telescope and observed them as if they were really planets. To his horror, he quickly realized that he could "see" many of the markings that appeared in Lowell's drawings of Venus.

Meanwhile, Lowell's preoccupation with Venus had not waned, and he worked on a memoir about his observations of the planet for the American Academy of Arts and Sciences when his rest cure took him to the French Riviera. Shortly after returning to Flagstaff in 1901, he sacked Douglass for "untrustworthiness" after learning that his second in command had sent a long letter to Lowell's brother-in-law, William Lowell Putnam, in which he had confided his misgivings about Lowell's "unscientific methods," culminating in the damning appraisal: "I fear it will not be possible to turn him into a scientific man."[21]

Despite the rupture with Douglass, for a time, even Lowell's faith in the spoke system was badly shaken by the results of his estranged assistant's "artificial planet" experiments. In 1902, he issued a retraction of his Venus work in the German journal *Astronomische Nachrichten*, an event unique in the career of this strong-willed, egotistical man. For a time Lowell would attribute the spokes to "optical effects of a curious and – astronomically speaking – of a hitherto unobserved character."[22]

Yet when Lowell resumed observing Venus the following year, the spokes reappeared, staring back at him "with a definiteness to convince the beholder of an objectiveness beyond the possibility of an illusion."[23] Never again would Lowell openly question the reality of these "peculiar and distinctive" markings, and he ultimately concluded that the hub of the spoke system was located near the point on Venus where solar heating was most intense, leading to a "funnel-like rise of hot stagnant air, creating a partial vacuum" that was "filled by draughts of cold air from the night side coming in from all sides of the periphery, thus giving rise to a spoke system."[24]

Lowell's habit of severely stopping down the aperture of his telescope gave his optical system a tiny exit pupil, the image of the objective opening (the so-called *entry pupil*) that emerges from the eyepiece as a circular beam of light. Employing a magnification of 140X with the aperture reduced to a diameter of only 1.6 to 3 inches yielded exit pupils ranging from less than 0.3 mm (0.01 in.) to little more than 0.5 mm (0.02 in.) in diameter. Narrow exit pupils make defects in the lens of an observer's eye stand out, as none other than Douglass himself had pointed out in an article entitled "Atmosphere, Telescope, and Observer" that appeared in the June 1897 issue of *Popular Astronomy* magazine:

> Perhaps the most harmful imperfection of the eye is the lack of homogeneity within the more dense transmitting media, either the lens or membranes, presumably the former. Under proper conditions the lens displays irregular circles and radial lines, the whole resembling a spider-web structure… These become visible when the pencil of light entering the eye is extremely minute and of the proper brilliancy, by the casting of their own shadows, as it were, on the retina and the absence of light from other parts of the pupil to drown them.[25]

Although Douglass never explicitly identified this "spider-web structure" as the source of Lowell's network of spokes on Venus, he was in Lowell's employ at the time and to do so would probably have been far too blatant an indiscretion.[26]

While there can be no doubt that Lowell's spokes and nodes were literally in the eye of their beholder, was the source of the illusion located in the lens of his eye, as Douglass may have suspected? An even more plausible explanation was proposed soon after I published a popular account of Lowell's Venus observations in *Sky & Telescope* magazine in 2002. Several ophthalmologists quickly pointed out that by stopping down the aperture of his telescope so severely, Lowell may have effectively converted it into an optical system resembling an *ophthalmoscope*, the instrument used to examine the concave interior surface of the eye opposite the lens, the *ocular fundus*.[27] An opthalmoscope shines a narrow pencil of light through the pupil of the eye and incorporates a perforated inclined mirror or a beamsplitter that permits the examiner to look along the axis of this incident beam of light with the aid of a low-power microscope.

The ocular fundus is the only part of the human body where the vascular network can be observed directly and non-invasively. Examining the ocular fundus has considerable value to physicians because its appearance provides information vital for diagnosing pathological conditions of the eye like glaucoma and can also reveal early signs of systemic disorders like diabetes, hypertension, and intracranial disease.

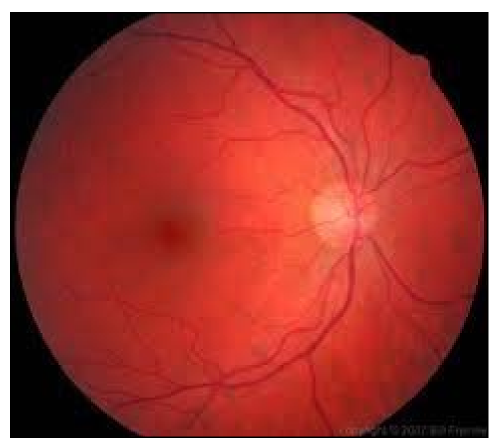


Figure 11: The network of blood vessels on the retina of the eye recorded with an ophthalmoscope. The resemblance to Figure 10 is quite striking.

Figure 12: Vesto Melvin Slipher.

A central artery sends a diverging network of blood vessels from a feature called the "optic cup" to supply blood to the retina. The veins that drain the retina also converge at this location. Formerly known as "Purkinje's tree" after the Bohemian physiologist Jan Purkinje (1787-1869) who first described their structure, this branching network of blood vessels is uncannily similar in appearance to Lowell's depictions of the spokes of Venus. All of these vascular structures overlie the photoreceptors, so patients undergoing an ophthalmoscopic examination are often able to see the shadows cast by their retinal blood vessels, especially when the light source is in motion.

Bear that morsel in mind and consider that when Lowell observed Venus in daylight with the objective of his telescope stopped down to a diameter of 3 inches, he was perched in the shadow cast by enormous tube of his telescope and sending a rather intense beam of light only half a millimeter in diameter into his eye, which must have required unremitting effort to keep centered. He may have accurately recorded what he saw, but he was probably transferring the vascular features of his own retina onto the surface of our neighbor world. This would convincingly explain the peculiarity noted by Antoniadi — namely that the spokes and nodes depicted in Lowell's sketches of Venus remained stationary with respect to the Earth rather than the Sun. It is also notable that Lowell's sudden death in 1916 was caused by a cerebral hemorrhage, usually the culmination of severe hypertension. In persons suffering from hypertension or exposure to high altitudes, the retinal blood vessels are often dilated and more prominent.

When Lowell "rediscovered" the spoke system in 1903, he realized that far more compelling evidence than drawings would be required to convince his detractors. The spectrograph offered a hopeful way to tackle the problem.

The measurement of Doppler shifts was emerging as one of the very cornerstones of 20th century astronomy. If a planet is rotating, one limb will approach the observer as the other recedes, both at the same velocity. The wavelength of light reflected from the morning and evening limbs will be displaced by the same amount but in opposite directions, causing any absorption lines in the spectrum to shift. Light from the approaching limb will be shifted toward the blue end of the spectrum, while light from the receding limb will exhibit an equal shift toward the red end of the spectrum. The magnitude of these opposing shifts will be proportional to the radial velocity of the planet's axial spin.

Lowell surmised that a failure of Doppler shifts to appear in spectrograms of the limbs of Venus would lend credence not only to Schiaparelli's captured rotation period, but also to his own much-ridiculed visual observations as well. He commissioned the Pittsburgh telescope maker John Brashear (1840-1920) to build a state-of-the-art spectrograph and hired a recent graduate of Indiana University, Vesto Melvin Slipher (1875-1969), to master the instrument's operation.

Slipher's careful work failed to detect any Doppler shifts, a result that Lowell did not hesitate to tout as "completely confirmatory of Schiaparelli's period and of my visual work."[28] Slipher, however, was far more cautious than his employer and refused to go out on a limb. He readily conceded that a 24-hour spin could not have escaped detection, but, citing the limited resolution of the Brashear spectrograph and the errors inherent in his measurements, he was unwilling to offer anything more precise than a conclusion that Venus turns slowly on its axis, probably not faster than once every 30 days.[29]

Adherents of a rapid rotation period cited two possible sources of error in the spectrographic method. First, if the rotational axis of Venus were obliquely inclined to our line of sight, the apparent velocity of approach and recession of the planet's limbs would be considerably reduced. Second, if the prevailing atmospheric currents were sufficiently rapid in the general direction of the planet's nighttime hemisphere, Doppler shifts might be masked.

While Slipher's spectrograms of Venus proved inconclusive, a few years later he would employ the Brashear spectrograph to investigate "spiral nebulae," then widely regarded as clouds of material swirling around comparatively nearby stars, perhaps nascent planetary systems. This work led to the most important discovery ever made at the Lowell Observatory, the unexpectedly high Doppler shifts of these objects. Within a decade, nearly all astronomers would realize that the spiral nebulae were other galaxies or "island universes," receding from one another at velocities of hundreds — or even thousands — of miles per second. The chain of events that led to the most fundamental astronomical revelation of the 20th century — an expanding universe far

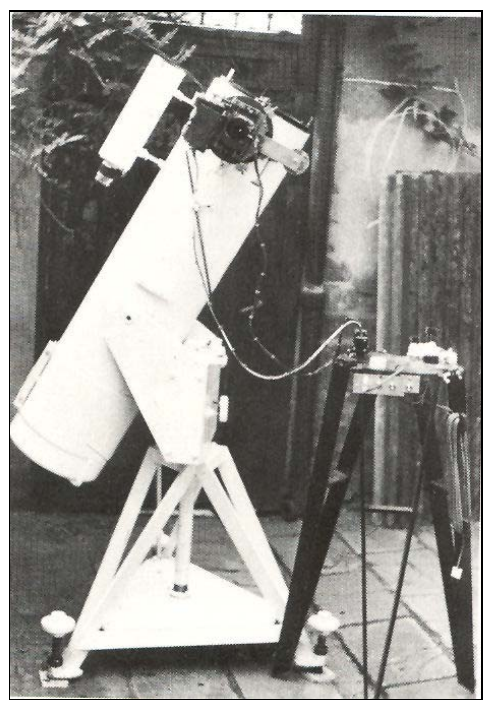


Figure 13: Charles Boyer's 10-inch Newtonian reflector.

more immense than anyone had dared to imagine — began with the pursuit of illusory markings on our closest planetary neighbor, markings that were in reality probably located only a fraction of a millimeter in front of the rods and cones of Percival Lowell's retina!

From the rotation of Venus to the expansion of the universe, the ridiculous to the sublime, a charming twist, perhaps, to an otherwise tragic tale. But by now you must be wondering if this is a story without a hero, let alone a happy ending. A hero would appear from a most unexpected quarter, but only after a lapse of more than half a century. In the interim, an unexpected discovery pointed to a way forward when visual observers were facing a dead end.

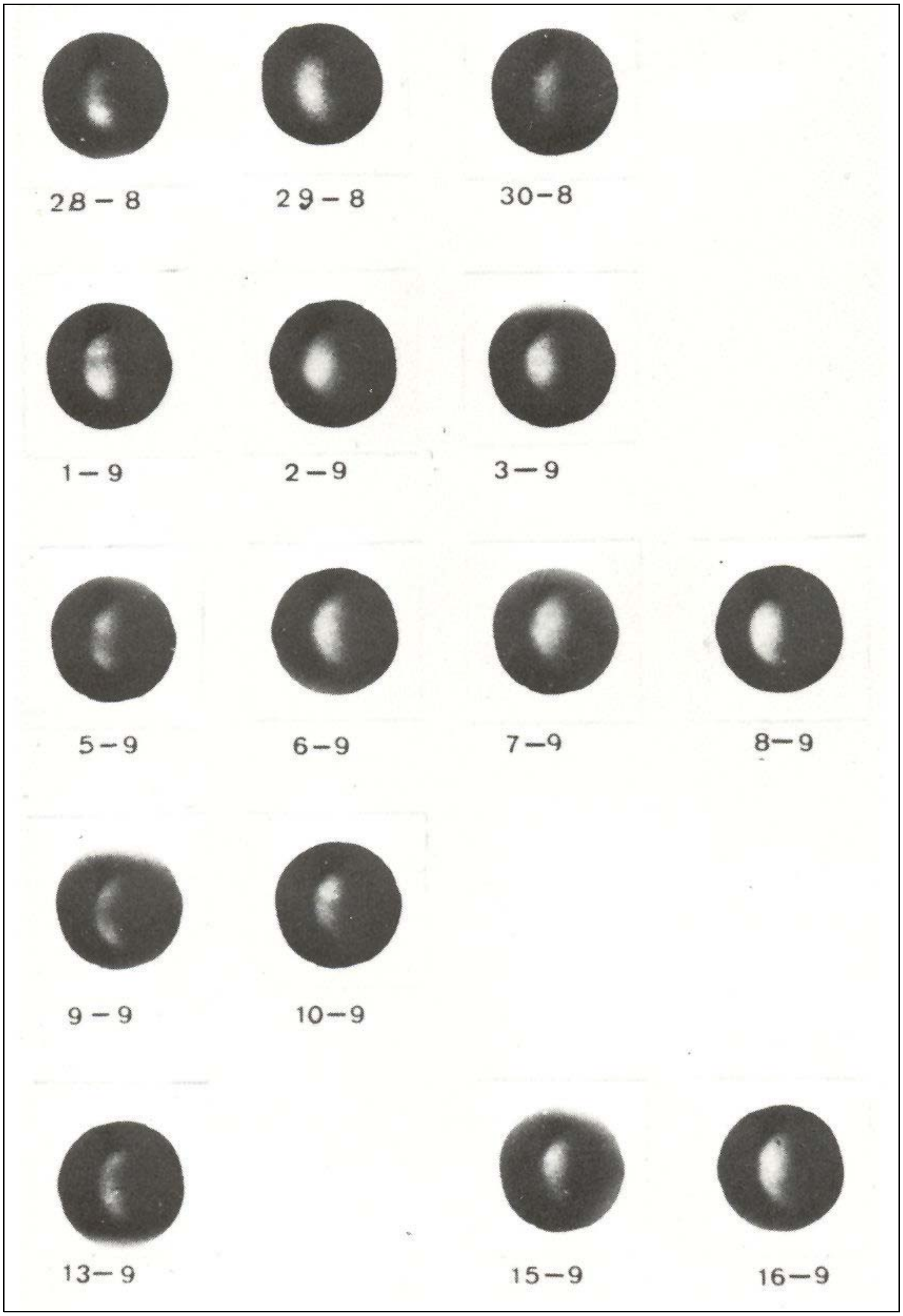


Figure 14: This series of Venus photographs taken by Boyer in August and September of 1957 revealed the 4-day rotation period of the planet's visible cloud canopy.

In striking contrast to the vague, elusive shadings accessible to the visual observer, Venus exhibits prominent features in ultraviolet light. The existence of these markings was first established by Frank Ross (1874-1960), a pioneer in the photography of the planets through monochromatic filters.[30] Using the 60-inch reflector at Mount Wilson Observatory, in 1927, Ross photographed Venus in six regions of the visible spectrum as well as in infrared and ultraviolet light. An infrared filter seemed to offer the greatest promise because of the ability of infrared light to penetrate atmospheric haze, providing the clearest views of the Earth's surface from aircraft flying at high altitudes. Even though aviation was in its infancy, infrared filters were already routinely employed in aerial photography.

To Ross' surprise, the photographs of Venus taken through an infrared filter were every bit as bland as those taken in visible light, but ultraviolet photographs at wavelengths of 340 to 370 nanometers captured a wealth of detail owing to localized concentrations of a UV-absorbing substance in the planet's upper cloud deck.[31] The identity of this material is still uncertain, but the best candidates seem to be elemental sulfur or compounds of sulfur and chlorine. This was the first time that photographs had recorded planetary markings that had eluded visual observers. The UV features took the general form of dusky bands at middle latitudes that ran roughly perpendicular to the terminator. A dark equatorial band was often present, usually sporting a diverging forked tail that formed a characteristic horizontal Y-shaped marking or chevron.

The UV features also appeared, albeit with greatly subdued contrast, in photographs taken through a violet filter that transmitted wavelengths of 380 to 400 nanometers, at the threshold of perceptibility to the normal human eye. This fact spurred British astronomer Patrick Moore (b. 1923) to suggest that the ability of some individuals to see deeper into the ultraviolet might account for the vexing differences in the depictions of Venus by visual observers:

> In the autumn of 1953, an interesting but very rough experiment

> was carried out by four planetary observers - R.M. Baum, J.B. Hutchings, C.D. Reid, and myself. Using a spectroscope, we found that Baum's eyes were unusually sensitive to light of short wavelength; Hutchings' and Reid's more normal, and my own rather insensitive. The significance of this is that Baum sees the streaky, cloudlike features clearly, and Hutchings and Reid with difficulty, while to me, they are invisible.[32]

Moore's inference was supported by the experience of the British astronomer Ewen Whitaker (b. 1922). Following cataract surgery, an operation that involved implanting plastic lenses to replace his yellowed and progressively beclouded ones, Whitaker determined with the aid of a monochromator that he was able to see ultraviolet light all the way down to a wavelength of 317 nanometers, which produced a color sensation indistinguishable from deep blue. Using a 6-inch reflector and a filter that transmitted only wavelengths shorter than 410 nanometers, he found that the characteristic photographic UV markings of Venus were easily visible, exhibiting the same level of contrast as the dappling of the "seas" on the Moon seen with the naked eye.[33]

Despite the prominent features that appeared in his ultraviolet photographs of Venus, Ross was unable to discern any obvious rotation period and only ventured a very tentative, cautious estimate of about 30 days, just like Slipher. Thirty years would pass before Ross's findings would be exploited, not by a professional astronomer, but by a French amateur named Charles Boyer (1911-1989). Born in Toulouse, Boyer was an avid motorcyclist and pilot who trained as a lawyer. At an early age he experimented with wireless, the basis of his life-long friendship with fellow "ham" radio enthusiast Henri Camichel (b. 1917), a professional astronomer at the Pic du Midi Observatory in the French Pyrenees.

Shortly before the Second World War, Camichel imparted to Boyer an interest in astronomy. During a 1992 interview over a bottle of wine in his backyard garden in Toulouse, Camichel explained that in France the gulf separating professional and amateur astronomers was never very wide. A number of great French planetary astronomers began their careers as amateurs, some never forsaking their amateur status. The great Eugène Antoniadi, for instance, always referred to himself simply as an "astronom voluntaire de l'Observatoire Meudon.". It was natural, therefore, for Camichel and Boyer to continue their association following the war, when Boyer embarked on a career in colonial Africa as Chief Magistrate at Dahomey (now Cotonu) and finally as President of the Bench at Brazzaville in the Congo, a position he held from 1955 until his retirement in 1963.

At Brazzaville, located only four degrees south of the equator, the planets were favorably placed for observation high in the sky and the humid atmosphere was often exquisitely free of turbulence. Realizing his opportunity, Boyer constructed a 10-inch reflecting telescope around a primary mirror made by the renowned optician Jean Texereau. The resulting instrument was optically superb but rode atop a rather rudimentary mounting. Boyer asked Camichel to suggest observing projects. It so happened that Camichel was photographing Venus in the ultraviolet at the time, and he proposed that his friend also attempt to do so.

Lacking a clock drive, Boyer's telescope was ill-suited to taking photographs of the planets, which required exposures several seconds in duration. Using parts from a Meccano erector set, the resourceful amateur cobbled together an ingenious device for moving his camera at precisely the right rate across the focal plane of his telescope. In August and September of 1957, when the air was unusually dry at Brazzaville, he began to photograph Venus, which was then well-placed in the evening sky. He employed a deep blue-violet filter that transmitted wavelengths shorter than 450 nanometers and Kodak Micro-File film, a high-contrast, fine-grained emulsion that is painfully slow by today's standards.

The Venus images in Boyer's photographs were extremely small and aesthetically unappealing, capturing far less detail than the photographs taken by Ross three decades earlier. Yet Boyer was soon able to discern the same dusky patch returning to the terminator at intervals of about four days. This feature made five returns between August 28 and September 16. Alerted to the suspected four-day rotation period by Boyer, Camichel examined his own images and also found evidence for this four-day period. Boyer continued his observing campaign from Brazzaville until 1960. By this time he and Camichel had come to regard the four-day *retrograde* (east to west) rotation of the upper atmosphere of Venus as "completely uncontestable."

In 1957 Boyer had taken the precaution of depositing a sealed envelope describing his discovery with the French *Academie des Sciences*. Not everyone was able to see the pattern in his tiny images. In a 1992 interview with William Sheehan, the eminent French planetary observer Audouin Dollfus (b. 1924) recalled: "I examined the images carefully. They did not seem to me completely convincing at the time."

But with Camichel's unflagging support Boyer persisted. The four-day rotation became his *idée fixe*. In fact, he did no other astronomical work of any real importance. His first published article, co-authored by Camichel, appeared in the popular magazine *L'Astronomie* in 1960, followed by papers in the prestigious journals *Annales d'Astrophysique* and the *Comptes Rendus de l'Academie des Sciences*. They failed to attract much attention or to elicit many comments.

Recognition of Boyer's discovery was agonizingly slow. In the meantime, in 1962 radar impulses bounced off Venus by radio telescopes in the United States and the Soviet Union revealed a very slow 243-day retrograde rotation period for the solid body of the planet, a finding that seemed utterly incompatible with a four-day rotation for the upper atmosphere. It was hard to imagine that the atmosphere of Venus could rotate 60 times faster than the underlying surface because the fastest winds ever clocked on Earth move five times slower than our planet's rotation rate. When Boyer and Camichel submitted a paper on the four-day rotation to *Icarus*, the leading international journal of planetary science, shortly after the announcement of the radar results, one of the referees, a rising star among planetary scientists named Carl Sagan (1934-1996), rejected it on the grounds that "the four-day rotation is theoretically impossible and shows how foolish the work of the inexperienced amateur can be."

In 1962, Dollfus and his colleagues Jean Rosch and Jean-Claude Pecker persuaded the International Astronomical Union to organize a world-wide photographic surveillance of Venus in the ultraviolet, carried out at several observatories, notably the Pic du Midi, New Mexico State University, Lick, and Lowell. Following his retirement from the bench in 1963, Boyer himself frequently worked beside his professional colleagues at the Pic du Midi, where he and Pierre Guerin succeeded in obtaining scores of UV photographs of the planet in broad daylight through a 42-inch reflector. They were able to continuously follow the motions of the UV markings from east to west for periods of up to six hours. These observations indicated wind speeds of about 83 meters per second in the early morning near the terminator. As the markings approached the subsolar point, their drift accelerated, reaching velocities of 122 meters (400 feet) per second during the afternoon, evidence of the heat engine that drives the "super-rotation" of the atmosphere.

In 1964, yet another French astronomer, Bernard Guinot of the Haute-Provence Observatory, employed a very sensitive technique known as "interference spectroscopy" to very precisely measure Doppler shifts and determine the radial velocities at various points on the limb of Venus. His data also suggested that the cloud canopy circulates once every 4.3 days near the equator. The final, irrefutable proof of Boyer's discovery did not come until 1974, when the Mariner 10 spacecraft imaged the planet in the ultraviolet during its approach. When these images were combined into a cinematographic sequence, the four-day retrograde rotation of the upper atmosphere was dramatically confirmed. Dollfus recounted to Sheehan that when Boyer was shown a copy of this film, he reacted with *la belle indifference*. It contained no surprise, since he already knew the result.

So how did Boyer manage to solve one of planetary astronomy's oldest and most persistent mysteries, an enigma that had defeated the best efforts of astronomers for over three centuries? He was very clear in his purpose and used an excellent telescope in a favorable climate, but even these factors cannot explain his remarkable achievement. Three decades earlier, after all, Ross had employed far more powerful instruments that recorded far more detail. Here, ironically, even Boyer's seeming deficits worked to his advantage. Dollfus later explained "Lack of resolution in this case helped by making the true picture of what was happening clearer. On images of Venus taken with larger instruments, such as those by Ross and our own at the Pic du Midi, there were simply too many details. The sheer plethora of markings confused matters."

Dollfuss' insight that low-resolution rather than detailed "can't see the forest for the trees" images were a help rather than a hindrance to Boyer is supported by the experiences of the only visual observer who can claim some measure of credit in independently discovering the rotation period of the atmosphere of Venus, Pennsylvania amateur Rodger W. Gordon (b. 1940). In the November 1962 issue of the newsletter of his local astronomy club, the Lehigh Valley Amateur Astronomical Society, Gordon published a brief account of his observations of Venus early the previous summer, accompanied by cautious disclaimers "Needless to say, I don't have much confidence in my findings, but for what they are worth, Venus rotates in about four Earth-days… It would not be surprising if I am considerably off the mark, as many others certainly have been."

Unaware of Boyer's results, at every opportunity, Gordon had observed Venus with a violet filter through 4- and 6-inch telescopes. Rather than sketching the planet, he simply assigned a value to the changing duskiness of the terminator region on an arbitrary numerical scale. When the intensity estimates obtained over a span of 10 weeks were plotted on a graph, a sine wave with four- to five-day period appeared. Gordon recalls that when the radar results of a 243-day retrograde rotation period were announced later that year, "I was sorry I ever wrote the article and felt like crawling into a hole!"

Boyer the magistrate made exceptionally judicious use of the meager facts at his disposal. When Dollfus was asked if he thought Boyer had been justified in divining the four-day rotation period from his 1950s images or had merely been lucky, he hesitated a few moments before responding: "Difficult to say. In between. As an amateur, he had more freedom. He was not tied to the same high standards of rigor that he would have been as a professional."

Boyer had taken a chance and stepped out on a limb. Three centuries of study had produced a legacy pathetically barren of results. The field had been all but abandoned when a persistent, single-minded amateur made one of the last important discoveries in the history of Earth-based planetary astronomy. For all its many foibles, the human factor, it would seem, is indispensable after all.

References

1. For an excellent collection of case studies of scientific fraud see William Broad and Nicholas Wade, *Betrayers of the Truth: Fraud and Deceit in the Halls of Science* (New York: Simon and Schuster, 1982).

2. Gerard P. Kuiper, "*On the Martian Surface Features*" **Publications of the Astronomical Society of the Pacific**, 67, 398 (1955), 271-282.

3. William Herschel, *Philosophical Transactions*, 83 (1793), 201-209.

4. J.H. Schroeter, ***Aphroditische Fragmente***, (Helmstedt, 1796), pp. 13-15.

5. Sir John Herschel, *Outlines of Astronomy* (New York: P.F. Collier & Son, 1852), p. 424.

6. The British telescope-maker George With (1827-1904) used a 12-inch reflector with an unsilvered primary mirror to observe Venus. He claimed that the feeble reflection from bare glass gave beautifully defined images of Venus, which appeared "marbled or veined all over." See T.W. Webb, *Celestial Objects for Common Telescopes*, 6th Edition. (London: Longmans, Green, and Company, 1917), p. 71.

7. J. Hedley Robinson, *Using the Telescope* (London: David & Charles, 1978), p. 66.

8. William F. Denning, *Telescopic Work for Starlight Evenings* (London: Taylor and Francis, 1891), p. 151.

9. Leo Brenner, *Spaziergänge durch das Himmelszelt* (Leipzig: Eduard Heinrich Mayer, 1898), pp. 118-119. See also Martin Stangl, "The Forgotten Legacy of Leo Brenner" ***Sky & Telescope***, 90, 2 (1995), 100-102.

10. Richard Baum, *"Franz von Paula Gruithuisen and the Discovery of the Polar Spots of Venus"* ***Journal of the***

British Astronomical Association, 105, 3 (1995), 144-147. Long dismissed as illusions, the cusp caps appear in images taken by the Mariner, Pioneer Venus, and Galileo spacecraft as brilliant polar hazes towering above the main cloud deck. Generations of visual observers also reported dusky *cusp collars* bordering the cusp caps. Images from the Pioneer Venus probe suggest that these features are rings of cooler clouds located at about 70 degrees north and south latitude that are roughly concentric with the planet's poles.

11. G.V. Schiaparelli, *"Considerazioni sul Moto Rotatario del Pianeta Venere"* ***Opere*** 5 (1890), 400-410.

12. W. Villiger, "Die Rotatzionszeit des Planeten Venus mit einem Anhang, enthaltend Beobachtungen der Oberflächenbeschaffenheit der Planeten Venus und Merkur" ***Neue Annalen der königlichen Sternwarte München***, 3 (1898), 303.

13. Joseph Meurers, *Astronomische Experimente* (Berlin: Akademie-Verlag, 1956), pp. 25-27.

14. During a surprise visit to a meeting of the British Astronomical Association in 1910, Lowell gave a brief talk that included the remark: "It has been said that the best Indian of all is the dead Indian, and so the most perfect aperture you can use is no aperture at all. Just as you get down to nothing, so your image will improve." See "Report on the Meeting of the Association, March 30, 1910," pp. 287-289.

15. Percival Lowell, "Atmosphere: In Its Effects on Astronomical Research," a lecture text circa 1897 in the Lowell Observatory Archives.

16. Percival Lowell, *"The Rotation Period of Venus"* ***Astronomische Nachrichten*** 3406 (1896), 361-364.

17. Percival Lowell, "Determination of the Rotation and Surface Character of the Planet Venus" ***Monthly Notices of the Royal Astronomical Observatory*** 57 (1897), 148.

18. Report of Meeting of the Royal Astronomical Society, ***Observatory*** 19, (1896) 420.

19. E.M. Antoniadi, "The Rotation Period of Venus" ***Journal of the British Astronomical Society*** 8 (1897), 43-46.

20. A.E. Douglass "The Markings of Venus" ***Monthly Notices of the Royal Astronomical Society*** 58 (1898), 382-385.

21. Douglass to Putnam, March 12, 1901. This letter is preserved in the University of Arizona Special Collections. Douglass' break with Lowell is recounted in George Ernest Webb, *Tree Rings and Telescopes: The Scientific Career of A.E. Douglass* (Tucson: University of Arizona Press, 1983), pp. 43-49.

22. Percival Lowell, "*The Markings on Venus*" ***Astronomische Nachrichten*** 3823 (1902), 129-132.

23. Percival Lowell, "Venus in 1903" ***Popular Astronomy*** 12 (1904) 184-190.

24. Percival Lowell, *The Evolution of Worlds* (New York: MacMillan, 1910), pp. 79-82.

25. This article was reprinted in *Amateur Telescope Making Advanced* (New York: Scientific American, 1937), pp. 585-605.

26. In personal correspondence with the authors, Macalester College astronomer Sherman W. Schultz, who maintained a private optometry practice for 40 years, noted that an opaque disk containing a suitably illuminated pinhole one millimeter or less in diameter placed in front of the eye can reveal the presence of pre-cataract opacities in the lens. These defects in the lens of the eye often take the form of a striated radial pattern that resembles Lowell's spoke system and may account for the curious results of the "artificial planet" experiments conducted by the German amateur astronomer W.W. Spangenberg in 1952. In a fashion similar to the experiments performed by Villiger and Douglass half a century earlier, Spangenberg's subjects viewed smooth, featureless balls through small telescopes. Some recorded cruciform patterns reminiscent of Lowell's radial spoke system.

27. The authors are indebted to the Mount Vernon, Ohio eye surgeon Roger H. Sherman, MD, and Phillip Steffey of Daytona Beach, Florida, for independently offering these insights.

28. Letter from Percival Lowell to President Henry S. Pritchett of the Massachusetts Institute of Technology, March 23, 1903. Cited in William Graves Hoyt, *Lowell and Mars* (Tucson: University of Arizona Press, 1976), p. 117.

29. V.M. Slipher, "*Spectrographic Investigation of the Rotation of Venus*" ***Lowell Observatory Bulletin 3***, June 1903.

30. Frank E. Ross, "*Photographs of Venus*" ***Contributions from the Mount Wilson Observatory***, 363 (1928), 22.

31. The infrared filter employed by Ross transmitted in the near infrared at wavelengths shorter than 900 nanometers. The clouds of Venus become partially transparent at longer wavelengths, making it possible to image the planet's surface topography. At wavelengths of one to two micrometers, the cooler highland regions appear darker than their surroundings. See D.A. Allen and J.W. Crawford, "*Cloud Structure on the Dark Side of Venus"* ***Nature*** 307 (1984), pp. 222-224.

32. Patrick Moore, *A Guide to the Planets* (New York: W.W. Norton & Company, 1954), p. 62.

33. Ewen A. Whitaker, "*Visual Observations of Venus in the UV*" ***Journal of the British Astronomical Association***, 99, 6 (1989), 296-297.

Feature Story

Whole-Disk Brightness Measurements of Mars: 2009-2010

By Richard W. Schmude, Jr.,
schmude@gdn.edu

Abstract

A total of 33 whole-disc V-filter brightness measurements of Mars are summarized in this report. The data are consistent with Mars being dimmer than expected in 2010. Hellas became "brilliant" later in 2010 than in 1995. The brightness data and the delayed brightening of Hellas are consistent with that planet having less cloud/frost cover in 2010.

Introduction

People have noted bright areas on Mars for well over 100 years. As an example, Antoniadi mentioned Schiaparelli's description, in the 1880s, of Hellas as appearing brilliant especially when it was near the edge of Mars' disc (Antoniadi, 1975, 92). Similar descriptions of Hellas were made in 1980, 1995 and 2010 (Asada et al., 2010, CMO 370-374), (McKim 1984, 2005).

Attempts have been made to study the average cloud coverage on different dates throughout the Martian year. Beish and Parker (1988, 373), for example, carried out a study of Martian clouds between the 1960s and 1980s. They found that both morning and evening limb clouds were more abundant during late northern spring on Mars than at other times. Parker and co-workers (1999, 3) also report that discrete clouds were more abundant on Mars in 1996-1997 than in the two previous apparitions. McKim (1999) published an extensive review of dust clouds on Mars based largely on telescopic observations. He classified these storms based on size. McKim (1999, 136) shows that dust storms are more frequent at $L_s \sim 270°$ than at other times. (The areocentric longitude, L_s, defines seasons on Mars; the start points for the spring, summer, fall and winter seasons for Mars' northern hemisphere are $L_s = 0°, 90°, 180°$ and $270°$, respectively).

In spite of recent studies of clouds and dust on Mars, little is known about the relative cloud, dust and frost coverage on Mars from one year to the next. For example, one may ask "Does Hellas get brighter at the same L_s value each year?" or "Is the seasonal increase in cloud covering the same every year?" To answer these questions, quantitative brightness data are needed.

One way to monitor long-term changes of cloud and frost coverage on Mars is with photoelectric magnitude measurements. This is because condensate clouds and frost cause that planet to be brighter. For example, according to Mallama's brightness model, (Mallama, 2007, Table 8) Mars is about 0.06 magnitudes brighter at $50° < L_s < 130°$ than at $230° < L_s < 310°$. Much of this brightening is due to the large number of limb clouds that develop on Mars at $50° < L_s < 130°$. Therefore, brightness measurements are one method of making quantitative measurements of cloud and frost coverage on Mars.

Mallama (2007) has published a model that predicts the brightness of Mars in filters transformed to the Johnson U, B, V, R and I system. His model incorporates brightness changes caused by both longitude and seasonal cloud/frost changes. This model is based on data collected between 1954 and 2006.

In this report, brightness measurements made during the 2009-2010 apparition are reported and are compared to predicted values (Mallama, 2007). The seasonal brightness of Hellas is also examined. The objectives of the current study are: 1) yield data on the overall brightness of Mars in 2009-2010, 2) measure the affects (if any) of the redistribution of dust as a result of dust storms during conjunction and 3) compare the observed brightness to the predicted brightness to see if Mars was brighter or dimmer than expected.

Method and Materials

An SSP-3 solid-state photometer along with a 0.09 meter (3.5 inch) Maksutov telescope and a filter that was transformed to the Johnson V system were used in making all brightness measurements. More information about the equipment can be found elsewhere (Schmude, 1992), (Optec, 1997). The following comparison stars and corresponding magnitudes (in parentheses) were used: alpha-Arietis (2.00), epsilon-Tauri (3.53), iota-Geminorum (3.79) and mu-Leonis (3.90). Magnitudes are from Iriarte et al. (1965) and Westfall (2008). Table 1 shows the brightness measurements of Mars made in 2009-2010. In all cases, these values were corrected for both atmospheric extinction and color transformation. The two-star method was used in evaluating color transformation corrections (Hall and Genet, 1988).

Figure 1A shows a graph of brightness measurements versus the date. Mars reached a peak brightness of about magnitude -1.4 near opposition in 2010.

Results

Positional data of Mars in the Astronomical Almanac (2007, 2008) along with brightness measurements made in 2009-2010 were used in computing observed minus predicted (o – p) magnitude values based on Mallama's model. These values are plotted in Figure 1B. The uncertainty for each value is approximately three times the diameter of the filled circles in the figure.

During the early months of the apparition, before February 2010 ($L_s \sim 45°$), the observed brightness of Mars was close to the predicted values. Therefore, any redistribution of dust from dust storms that may have occurred during conjunction had little effect on the brightness. Starting in February, 2010 Mars was dimmer than

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.

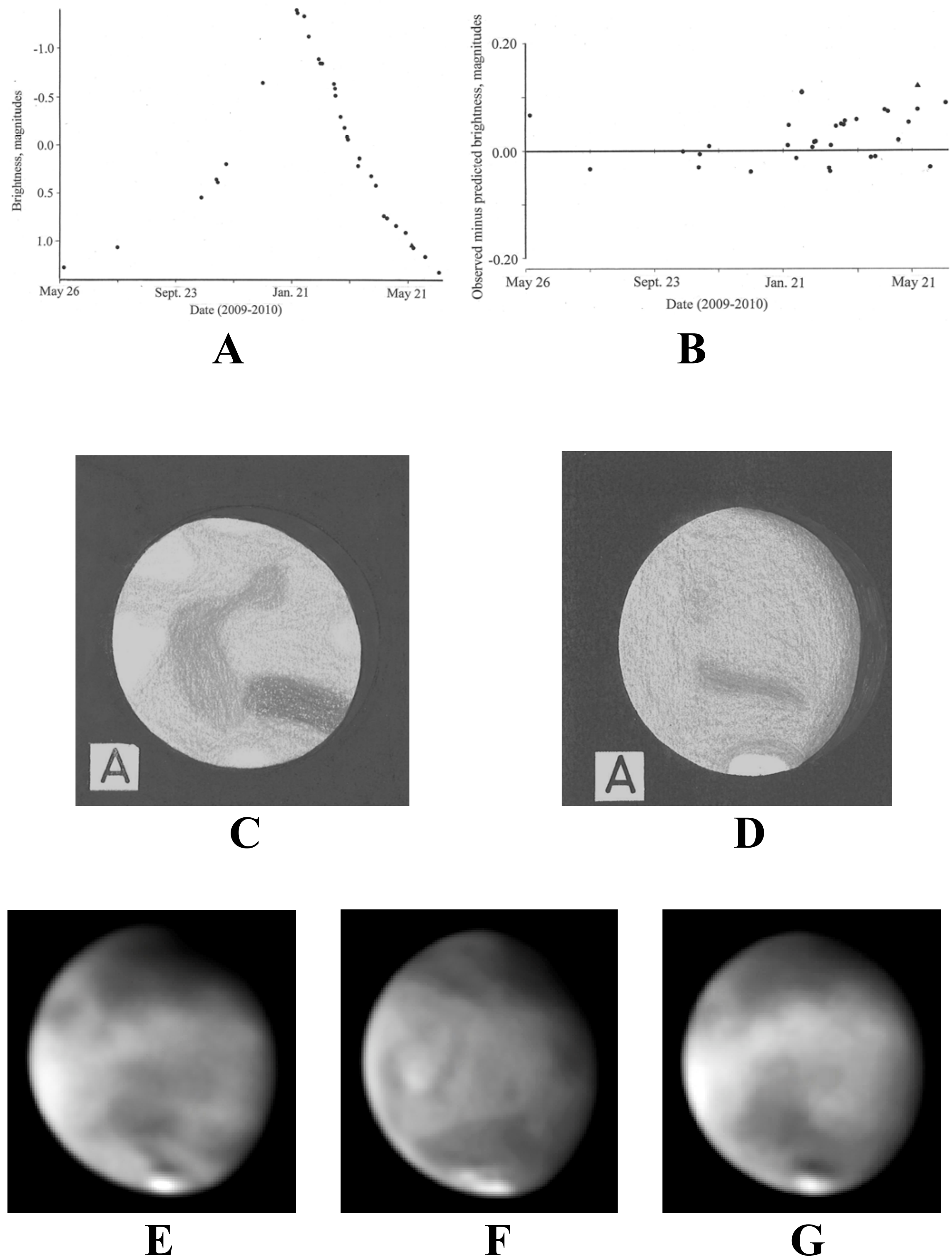


Figure 1. A: A graph of the measured brightness of Mars versus the date in 2009-2010; all brightness measurements were made with an SSP-3 solid-state photometer and a filter transformed to the Johnson V system. B: A graph of the observed minus predicted brightness, in magnitudes, versus the date in 2009-2010. C: A drawing of Mars made by the writer on May 1, 1995 at 3:40-4:02 UT with a 0.09 m refractor at 250 X, seeing = 7, L_S = 92°, longitude of the central meridian (or λ) = 198° W, disc center = 20° N. D: A drawing of Mars made by the writer on May 16, 2010 at 2:13-2:28 UT with a 0.12 m refractor at 200 X, seeing = 7, L_S = 91°, λ = 177° W, disc center = 21° N. E: April 22, 2010 (2:17 UT) by Don Parker, green filter (520 nm) L_S = 81°, λ = 45° W. F: May 5, 2010 (0:37 UT) by Don Parker, green filter (520 nm), L_S = 87°, λ = 257° W. G: May 27, 2010 (1:06 UT) by Don Parker, green filter (520 nm), L_S = 96°, λ = 53° W.

Table 1: Brightness Measurements of Mars During 2009 and 2010

Date	Solar Phase Angle (degrees)	Longitude of Central Meridian	L_S (degrees)	Brightness (magnitudes)	Comparison Star
May 30.391, 2009	28.1	344° W	275	1.28	α-Arietis
July 25.376	34.3	147° W	310	1.07	ε-Tauri
Oct. 19.428	39.8	55° W	356	0.56	ι-Geminorum
Nov. 3.460	39.2	283° W	4	0.37	ι-Geminorum
Nov. 4.453	39.1	271° W	4	0.40	ι-Geminorum
Nov. 13.448	38.3	183° W	9	0.20	ι-Geminorum
Dec. 22.263	27.4	116° W	27	-0.64	ι-Geminorum
Jan. 26.153, 2010	4.1	127° W	43	-1.38	ι-Geminorum
Jan. 27.205	3.5	136° W	43	-1.35	ι-Geminorum
Feb. 3.181	4.7	57° W	47	-1.31	ι-Geminorum
Feb. 8.144	8.2	83° W	49	-1.11	ι-Geminorum
Feb. 18.115	15.5	272° W	53	-0.88	ι-Geminorum
Feb. 20.236	17	297° W	54	-0.83	ι-Geminorum
Feb. 21.085	17.6	235° W	54	-0.82	ι-Geminorum
March 5.050	24.4	115° W	60	-0.62	ι-Geminorum
March 6.041	24.9	103° W	60	-0.58	ι-Geminorum
March 7.043	25.4	94° W	61	-0.50	ι-Geminorum
March 12.061	27.7	55° W	63	-0.29	ι-Geminorum
March 16.122	29.3	40° W	65	-0.18	ι-Geminorum
March 19.088	30.3	1° W	66	-0.08	ι-Geminorum
March 20.128	30.7	5° W	66	-0.05	ι-Geminorum
March 31.167	33.7	277° W	71	0.21	ι-Geminorum
April 1.083	33.9	239° W	72	0.15	ι-Geminorum
April 13.099	35.9	131° W	77	0.32	ι-Geminorum
April 17.083	36.4	88° W	79	0.42	ι-Geminorum
April 26.099	37.1	9° W	82	0.74	ι-Geminorum
April 29.065	37.3	328° W	84	0.76	ι-Geminorum
May 9.115	37.4	250° W	88	0.83	μ-Leonis
May 18.119	37.3	166° W	92	0.91	μ-Leonis
May 25.163	37.1	114° W	95	1.06*	μ-Leonis
May 26.083	37.1	76° W	96	1.07	μ-Leonis
June 8.082	36.3	310° W	102	1.16	μ-Leonis
June 21.102	35.2	191° W	107	1.31	μ-Leonis

* Difference in air mass between Mars and the comparison star exceeded 0.3 air masses and, hence this measurement is somewhat uncertain.

expected. (Note that if the o – p value is greater than zero Mars is dimmer than expected.) Table 2 summarizes the average o – p brightness values of Mars, in magnitudes, for different ranges of the L_s values for the 2007-2008 and 2009-2010 apparitions. During 2009-2010, Mars was dimmer than expected for $45° < L_s < 107°$. This may have been due to a lower coverage of clouds and/or ground frost in 2010 than between 1954 and 2006. Mars was also a bit dimmer than expected for $45° < L_s < 90°$ during the 2007-2008 apparition.

One feature that may be sensitive to seasonal changes is Hellas. This is a large depression in Mars' southern hemisphere. During warm or low-humidity winters, Hellas may not get as bright as in other winters. This in turn would affect Mars' brightness. Accordingly the writer examined his 1995 drawings and notes of Hellas along with those of others (Minami et al., 1995, CMO155, 157-158, 162-164), (Asada et al., 2010, CMO 370-374), (McKim, 1984, 2005). (Essentially, Hellas starts becoming bright during northern spring or southern fall). It first appears bright only when it is near the limb or terminator but as the temperature drops it becomes bright even near the central meridian. Since Hellas is in the southern hemisphere, winter begins at $L_s = 90°$.

Descriptions of how Hellas brightened in 1980, 1995 and 2010 are given in Table 3. There is a sizable difference between 1995 and 2010. During 2010, Hellas did not get bright at the disk center until $L_s = 83°$; however, Hellas was bright at the disc center in 1995 when $L_s = 65°$. Therefore, Hellas brightened much later in 2010 than in 1995. This is consistent with Mars being dimmer in 2010 than in 1995.

Figures 1C and 1D show two drawings of Mars made by the writer. These drawings were made on May 1, 1995 and May 16, 2010, respectively. Mars is at nearly the same orientation and season in both drawings. Note that the May 1, 1995 drawing shows three bright areas on the left and right edges of Mars, but that the May 16, 2010 drawing shows no bright areas on the left and right edge of Mars. Figures 1E-1G show green light images recorded by Don Parker in 2010. Parker captured some cloud activity but the clouds are not very thick. These drawings and images are consistent with Mars being dimmer than expected in April and May of 2010.

Figure 2 shows three blue filter images of Mars taken in May and June of 2010. Note the lack of bright limb clouds in the images.

Conclusion

During 2010 ($45° < L_s < 107°$) Mars was dimmer than expected. The largest discrepancy occurred after $L_s = 90°$. This may be due to a lower number of clouds in mid-2010 than during the 1990s. Hellas grew brighter at a later seasonal date in 2010 compared to 1995 and this is also consistent with Mars being dimmer in 2010.

Acknowledgements

The writer would like to thank Truman Boyle, Alan Bolton and Sally Bolton for their assistance.

References

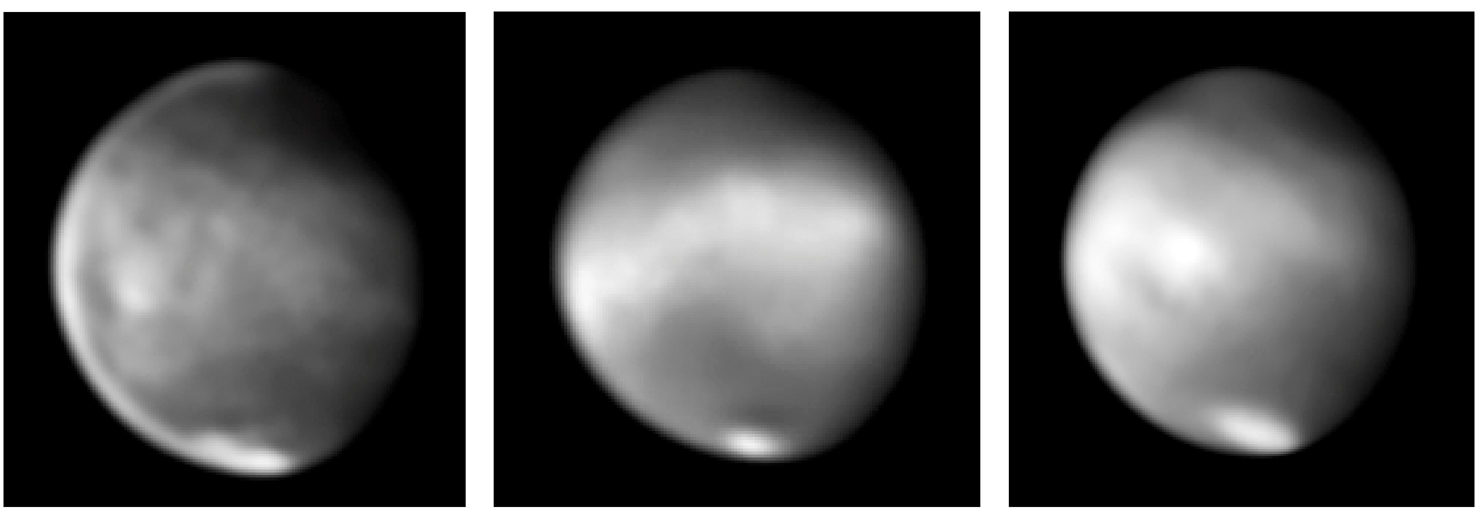
Antoniadi, E. M. "The Planet Mars" (Translated by Patrick Moore) Keith Reid Ltd. Shaldon Devon, 1975.

Asada, T., Minami, M., Murakami, M., Nakajima, T. and Nishita, A. "Communications in Mars Observations", published by the OAA Mars Section, Numbers 370-374, 2010.

Astronomical Almanac for the Year 2009, U. S. Govt. Printing Office, Washington DC, 2007.

Astronomical Almanac for the Year 2010, U. S. Govt. Printing Office, Washington DC, 2008.

Beish, J. D. and Parker, D. C. "Exploring Mars in 1988" *Sky & Telescope* magazine, Vol. 75 (April) pp. 370-374, 1988.



A B C

Figure 2. A: May 5, 2010, (0:39 UT) by Don Parker, blue filter (480 nm) $L_S = 86.5°$, $\lambda = 258°$ W; B: May 27, 2010 (1:01 UT) by Don Parker, blue filter (480 nm) $L_S = 96.2°$, $\lambda = 52°$ W; C: June 14, 2010 (1:28 UT) by Don Parker, blue filter (480 nm) $L_S = 104.3°$, $\lambda = 245°$ W. South is at the top and west is to the right in all images.

Hall, D. S. and Genet, R. M. “Photoelectric *Photometry of Variable Stars”* Second edition, Richmond, VA: Willmann-Bell Inc., 1988.

Iriarte, B, Johnson, H. L., Mitchell, R. I, and Wisniewski, W. K. “Five-Color *Photometry of Bright Stars”* *Sky & Telescope* magazine, Vol. 30 (July) pp. 21-31, 1965.

Mallama, A. “The *magnitude and albedo of Mars”* *Icarus*, Vol. 192, pp. 404-416, 2007.

McKim, R. “The opposition of Mars, 1980” *Journal of the British Astronomical Assn*, Vol. 94, pp. 197-210, 1984.

McKim, R. “The opposition of Mars, 1995” *Journal of the British Astronomical Assn*, Vol. 115, pp. 313-333, 2005.

McKim, R. J. “Telescopic Martian Dust Storms: A Narrative and Catalogue” *Memoirs of the British Astronomical Assn*, Vol. 44, pp. 1-165, 1999.

Minami, M., Nakajima, T. and Nishita, A. “Communications in Mars Observations”, published by the OAA Mars Section (Numbers 155, 157-158, 162-164) 1995.

Optec Inc. “Model SSP-3 Solid-State Stellar Photometer Technical Manual for Theory of Operation and Operating Procedures, Revision 3, Lowell MI: Optec Inc., 1997.

Parker, D. C., Beish, J. D., Troiani, D. M., Joyce, D. P. and Hernandez, C. E. “Telescopic Observations on Mars, 1996-1997: Results of the Marswatch Program” *Icarus*, Vol. 138, pp.3-19, 1999.

Schmude, R. W. Jr. “Photometric *and Polarimetric Observations of Mars in 2000-2002”* *Journal of the Royal Astronomical Society of Canada*, Vol. 96, pp. 105-110, 2002.

Schmude, R. W. Jr. “Mars: Photometric and Polarization Studies in 2005-2008” *Journal of the Assn of Lunar and Planetary Observers*, Vol. 51, No. 1 (winter) pp. 29-34, 2009.

Westfall J. E. “Photometric Catalog of Zodiacal Stars” ALPO Monograph No. 12, 2008.

Table 2: Summary of Observed Minus Predicted (o – p) Brightness Measurements for Different Ranges of the Areocentric Longitude (Ls) of Mars for the 2009-2010 Apparition*

L_S range	Average o – p brightness, magnitudes (number of measurements) 2007-2008 Apparition	Average o – p brightness, magnitudes (number of measurements) 2009-2010 Apparition
180°-225°	-0.040 (2)	---
225°-270°	-0.032 (1)	---
270°-315°	---	0.015 (2)
315°-0°	-0.015 ± 0.007 (16)	-0.001 (1)
0°-45°	0.008 ± 0.0003 (95)	-0.003 ± 0.005 (6)
45°-90°	0.012 ± 0.006 (7)	0.024 ± 0.002 (19)
90°-107°	---	0.050 ± 0.012 (5)
In all cases, the uncertainty is the standard deviation divided by the square root of the number of measurements. The number of measurements is given in parentheses.		

Table 3: Development of Hellas During 1980, 1995 and 2010 at Different Values of Mars’ Areocentric Longitude (Ls)*

	$50° < L_S < 60°$	$60° < L_S < 70°$	$70° < L_S < 80°$	$80° < L_S < 90°$
1980	bright on ml and el	very bright on ml	very bright on ml	bright at dc at L_S = 82°
1995	bright on ml and el	bright at dc	bright at dc	bright at dc
2010	dull	suspect white veil	bright at el, southern part is brighter than northern part	bright at dc at L_S = 83°
* In the table above, “ml” = morning limb, “el” = evening limb and “dc” = disk center.				

Feature Story:

Is Saturn's Storm of the 2010-11 Apparition Related to The Great White Spot (GWS)?

By Frank J. Melillo,
E-mail: *frankj12@aol.com*

Abstract

Saturn changed its face during the 2010-11 season. A white spot discovered in the North Temperate Belt (NTB) on December 5, 2010 by the Casinni spacecraft was followed by amateur astronomers throughout the entire apparition. This storm is enormous and similar to a Great White Spot (GWS) that spread rapidly around the Saturn globe. Also, it is comparable to the GWS cycle that occurred 27-30 years in Saturn's northern hemisphere. A question arises whether or not this storm fits into the cycle.

Introduction

Since the invention of the telescope, observers have noticed periodic disturbances, spots and ovals in the Saturnian atmosphere. These features tend to be small and sometimes even go unnoticed. Most of the time, the activity may never be large enough to be followed by most observers. Unlike Jupiter, with almost continuous disturbances, Saturn features tend to be somewhat hazier and are often in poor contrast. There are several reasons for the differences in atmospheric features between the two planets. First, Saturn is nearly twice the distance away from us and from the Sun, so it appears smaller and duller, plus Saturn is cooler and less active internally, so less activity is triggered. Also, the atmosphere is hazier so that most disturbances may be hidden.

This doesn't mean that there is nothing to see. Saturn may still offer surprises along the road. What appears first is the subtle spot that can turn into a monstrous storm. This feature is often white, circular in shape and is large enough to cover a large area. When this appears, we call it the Great White Spot (GWS).

We don't know the true nature of the GWS. It is a sudden appearance of ammonia crystals high above the visible layers of the atmosphere. The GWS is the brightest feature on the planet's globe when exposed to sunlight. The GWS is the only feature that can change Saturn's appearance suddenly. We are so familiar with Jupiter's disturbances that there is no comparison with Saturn. When the GWS appears, the attention of amateur and professional astronomers worldwide is drawn to it more than any other objects in the sky. Nothing can be better than the GWS when it is visible on the disk during the night's observing run. But, how often can the GWS appear? A person can be lucky if he witnesses the GWS at least twice in his lifetime!

All Readers

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

Online Features

Left-click your mouse on:

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

Table 1: Saturn's Great White Spot in History

Date	Ecliptic Longitude	Location	Latitude	Discoverer & Location
1876 Dec. 27	332	EZn	+5.0	Asaph Hall Washington, DC
1903 Jun 15	308	NTZ	+38	E. E. Bernard Yerkes Obs.
1933 Aug. 3	313	EZn	+5.0	Will Hay England
1960 Mar 31	287	NNTz	+58	J.H. Bothman South Africa
1990 Sept. 25	288	EZn	+08	Stuart Wilbur Las Cruces, New Mexico USA

Figure 1. First image of a Saturn white spot by this author. Image taken 2010 December 17 10:55 UT. Equipment: 10-in. Meade LX200 (SCT) with ToUCam Pro II webcam imager. Seeing: 4 - 5/10. CM I - 310°, CM II - 134°, CM III - 280°.

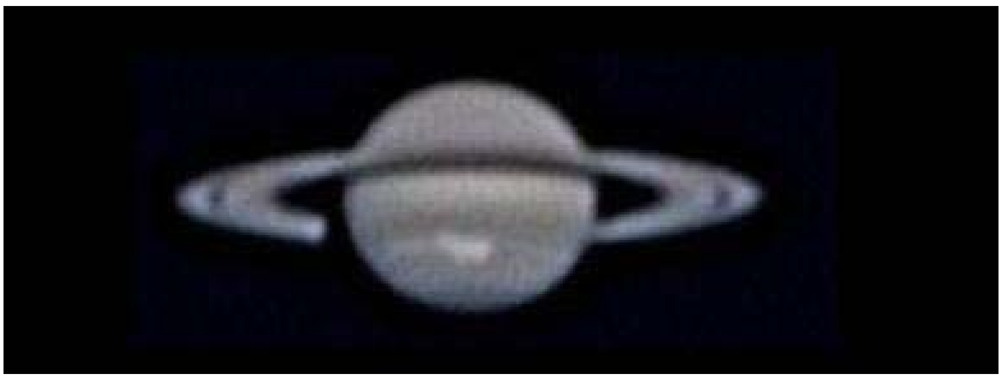


Figure 2. Second image of a Saturn white spot by this author. Note that spot is now brighter and larger. Image taken 2010 December 25 10:58 UT. Equipment: 10-in. Meade LX200 (SCT) with ToUCam Pro II webcam imager. Seeing: 4 - 5/10. CM I - 226°, CM II - 152°, CM III - 288°.

Some Great White Spot Documents of the Past

The appearance of the GWS is rare indeed — there are only five documented appearances of the GWS; 1876, 1903, 1933, 1960 and 1990, all of which occurred in the Saturnian northern hemisphere. The cycle is roughly 27-30 years apart. Saturn goes around the Sun in 29.5 Earth years. It seems that the GWS cycle is pretty well established.

Saturn goes through two solstices and two equinoxes during each orbit, just as the Earth does, but each season lasts just over seven years. When Saturn reaches its autumnal equinox, which represents 0 degree ecliptic longitude, autumn arrives in the northern hemisphere. At the winter solstice 90 degrees ecliptic longitude, winter arrives in the northern hemisphere. The vernal equinox at 180 degrees ecliptic longitude when spring arrives in the northern hemisphere and the summer solstice at 270 degrees ecliptic longitude, summer arrives in the northern hemisphere. This repeats every Saturniun year.

When summer arrives in the northern hemisphere at 270 degrees ecliptic longitude, it gets the maximum sunlight. When this occurs, the direct sunlight may trigger disturbances in the northern hemisphere, though iniitally, it might take some time for the atmosphere to heat up. A little later in the summer season, the direct sunlight may have some impact on energy and cause enormous plumes high up in the atmosphere to develop. This has occurred at every passage since 1876. (Before that year, the observations were very sporadic.) The only explanation is that this may be a seasonal effect.

When Saturn enters a certain part of the orbit after the northern summer solstice, the GWS bursts into view.

The first well-known report of the GWS occurred December 7, 1876, when Saturn was at 332 degrees ecliptic longitude. It lay along the Equatorial Zone north (EZn) discovered by Asaph Hall of Washington, DC. A second GSW was reported on June 15, 1903, when Saturn was at 308 degrees ecliptic longitude. This time, it lay further north along the North Temperate Zone (NTZ) discovered by E.E. Bernard of Yerkes Observatory. A third GWS was first seen August 3, 1933, when Saturn was at 313 degrees ecliptic longitude. Again, it lay along the EZn discovered by Will Hay of England. A fourth one was discovered March 31, 1960, when Saturn was at 287 degrees ecliptic longitude. It lay along the North North Temperate Zone (NNTZ) near the North Polar Region discovered by J. H. Botham of South Africa. The last official document of the GWS occurred September 25, 1990, when Saturn was at 288 degrees ecliptic longitude. It lay along the EZn which was discovered by Stuart Wilbur of New Mexico.

According to five well-known documents of the GWS, all occurances were within the range of 288 – 332 degrees ecliptic longitudes. That is roughly between early to mid-summer in the northern hemisphere. In the late 1980s, Saturn was entering the ecliptic longitude range. We then expected another outbreak of the GWS according to the 27-30 year cycle because 29 years have passed without any white spots being reported. A short article, “A White Oval Watch”, published by this author in the JALPO Vol. 33, No. 7-

9 July 1989 issue alerted many observers of a possible upcoming GWS. Later the following year in September 1990, sure enough, a small round feature suddenly appeared along the Equatorial Zone north (EZn) and it developed into a GWS. Saturn was within this ecliptic longitude range and it appeared right on schedule, according to the 27-30 year cycle.

Can We Call the Storm 2010 - 2011 a Great White Spot?

This author describes just a general appearance of the white spot. Many more details of the spot itself will appear in a future JALPO issue.

Saturn reached the vernal equinox (180 degrees ecliptic longitude) in August 2009 when spring arrived in the northern hemisphere. In October 2010, Saturn emerged from behind the Sun, thus marking the beginning of the 2010-2011 observing season. It was early spring in the northern hemisphere. In early December, something was detected by the Casinni spacecraft and some radio signals from the storm that was possibly forming were reported.

On December 9, 2010, several amateur astronomers braved the cold morning to report an unusual spot in the North Temperate Zone (NTB). Obviously, it became a brilliant intense white spot that caused much attention in many astronomical communities.

Two weeks after the first sighting, the white spot developed a tail-like feature on one side. Amateur and professional astronomers around the world got a real treat. They reported that the white spot was starting to stretch out because of strong winds in the upper atmosphere. The white spot was no longer a spot, but developed into a large white band that stretched around the Saturnian globe. After many months, the bright band overlapping the original sight of the spot continued to spread around the globe for the second time. Mottling and many smaller spots were seen within the bright band. The visibility of the storm showed no sign of declining and the contrast continued to be strong. The best part of all is that the storm lasted throughout the entire apparition and kept many amateur and professional astronomers busy. The storm of 2010-2011 appeared very similar to the GWS.

Conclusion

After the GWS appearance in 1990, we looked ahead to see whether or not we could predict another outburst of the GWS. Saturn's northern hemisphere will reach the summer solstice in May 2017, and it will then enter the 288 degrees – 324 degrees ecliptic longitude range where all five GWSs were seen in the past. If everything holds true, we can expect another outburst sometime during 2017 – 2021.

The 27-30 year cycle seems to be well established based on the GWS's history. But in addition to that, there is also another cycle which suggests an appearance every 57 years. The GWS spot alternated between the equatorial regions and to fairly high northern latitudes each time they appeared. In 1876, 1933 and 1990, the GWS was located in the equatorial region. All three appearances were 57 years apart. On the other hand, in 1903 and 1960, the GWS appeared at much higher latitudes in the north. Also, both are 57 years apart. Can we expect the next one to appear at a higher latitude in 2017 (1960+57 = 2017)? Either way, with a simple calculation like this, it seems like the GWS can be predicted quite easily. As of December 1, 2010, the next possible appearance of a GWS is still years away, or at least we can expect it toward the end of this decade.

Because it was early spring in the northern hemisphere, nobody expected anything major to happen in the atmosphere. Saturn was at 195 degrees ecliptic longitude and it was way ahead of its time for the GWS to appear during the 27-30 year cycle. By analogy, the Martian global dust storms occur more frequently during perihelion when it is the closest to the Sun while summer approaching the southern hemisphere. And yet in 2001, the global dust storm encircled the planet way ahead of the season. This may also apply to Saturn that the white spot occurred the same way ahead of the season. The storm of 2010-2011 appeared to behave like a Great White Spot and it was no different from the other five of the past.

How can the white spot of 2010-2011 be fitted into the 27-30 year cycle when it's only 20-21 years since 1990 when the last one occurred? Nobody knows for sure! But there is reason to believe that the white spot was the same phenomena as the previous ones in 1876, 1903, 1933, 1960 and 1990. Certainly, the 2010-2011 is in advance in Saturn's GWS season with respect to the previous (early springtime against summer time) storms. If this is not the case, can we expect the real one to occur in 2017-2021? We'll see! The Great White Spot Watch will be announced later this decade!

References

Alexander, A.F.O'D, *The Planet Saturn: A History of Observation, Theory and Discovery.* Dover Publication, New York, NY. 1962

Benton, J. L., "Monitoring Atmospheric Features on Saturn in 1991," *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 35, No. 1, 1991, pp. 24-25.

Hass, Walter H, "A Review of 5 Major Bright Outbursts on Saturn and a Suggested 57-Year period." <*http://alpo-astronomy.org/publications/Presentations/Haas%20-%20Saturn%20Outbursts.pdf*>. Conference of the Assn of Lunar & Planetary Obsrvers, 2006.

Melillo, F. J., 1989, "A White Oval Watch on Saturn?", *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 22, No. 7-9, 1989, p. 138.

Sanchez, A, 2011, Personal communication.

Westfall, J. E., 2011, Personal communication.

Feature Story:
ALPO Observations of Uranus and Neptune in 2010-2011

By Richard Schmude, Jr., coordinator, ALPO Remote Planets Section, *Schmude@gdn.edu*

Abstract

This report summarizes observations of Uranus and Neptune in 2010-2011. The selected normalized magnitudes of Uranus for the 2010-2011 apparition are: B(1,0) = -6.56 ± 0.05, V(1,0) = -7.134 ± 0.009, R(1,0) = -6.77 ± 0.02 and I(1,0) = -5.61 ± 0.05. The corresponding values for Neptune are: B(1,0) = -6.59 ± 0.03 and V(1,0) = -7.00 ± 0.03. Several people report faint albedo features on Uranus while others report no irregularities except for limb darkening.

Introduction

Professional astronomers published several new studies of Uranus and Neptune during late 2010 and early 2011. For example, Luszcz-Cook et al (2010) summarized near-infrared images of Neptune made on July 26 & 28, 2007 with the Keck Telescope. They reported that two bright clouds, visible in the images, were centered at latitudes of 89.07° S and 87.84° S. At times, they appeared as a single cloud. Each cloud appeared bright with a diameter of about 500 km. This group concluded that these clouds were at pressures greater than 0.4 bars (or 0.4 atmospheres). In a second study, Irwin et al (2010) used the United Kingdom Infrared Telescope to record spectra of Uranus during 2006-2008. These spectra enabled this group to set new constraints on models of Uranus' atmosphere. Karkoschka and Tomasko (2011) analyzed spectra of Neptune taken with the STIS spectrographs on the Hubble Space Telescope. The spectra were taken on August 3, 2003. They concluded that a thin stratospheric haze layer was present on Neptune. These two also reported that bright discrete clouds were most abundant at latitudes of 40° S and 30° N. They also reported that the upper troposphere of Neptune (pressure of around 0.2 atmospheres) was very clear. In addition to these studies, members of the ALPO also carried out recent studies of Uranus and Neptune.

Table 1 lists characteristics of Uranus and Neptune during their 2010-2011 apparitions. The people who submitted observations of these planets are summarized in Table 2. This report summarizes brightness measurements and drawings/images made of Uranus/ Neptune during 2010 and early 2011.

Brightness Measurements

Three different methods were used in measuring the brightness of Uranus and Neptune. These three were photoelectric photometry, visual photometry and photographic photometry. The results from these methods are summarized.

Photoelectric Photometry

Jim Fox and the writer made brightness measurements with an SSP-3 solid state photometer along with filters transformed to the Johnson B, V, R and I system. More information on the equipment can be found elsewhere (Optec., Inc, 1997), (Schmude, 1992, 20; 2008, Chapter 5). Jim Fox used 21-Piscium and Mu-Capricorni as the comparison stars for all of his Uranus and Neptune measurements, respectively. The writer used Lambda-Piscium and Iota-Aquarii as the comparison stars for all of his Uranus and Neptune measurements, respectively. The comparison stars and their brightness values are summarized in Table 3.

Tables 4 and 5 summarize brightness measurements made of Uranus and Neptune. The date, observer's initials, filter, measured brightness value and normalized magnitude value are listed in columns 1-5 and 6-10 in each table. Values of the normalized magnitudes, B(1,α) and V(1,α) are computed as:

$$\mathbf{B}(1,\alpha) = B - 5.0 \times \log[r \times \Delta] \qquad (1)$$

$$\mathbf{V}(1,\alpha) = V - 5.0 \times \log[r \times \Delta] \qquad (2)$$

In these equations, B and V are the B filter and V filter brightness value, r is the planet-Sun distance and Δ is the planet-Earth distance. Both r and Δ are in astronomical units. Extinction and color transformation corrections are included in all brightness measurements.

Jim Fox used 25-Piscium as a check star for his Uranus measurements. The average measured brightness of 25-Piscium are 6.292 (V filter) and 6.342 (B filter). The V filter result is close to the accepted value, but the B filter value is 0.07 to 0.08 magnitudes fainter

Table 1: Characteristics of the 2010 - 2011 Apparitions of Uranus, Neptune and Pluto[a]

Parameter	Uranus	Neptune	Pluto
First conjunction date	Mar. 17, 2010	Feb. 14, 2010	Dec. 24, 2009
Opposition date	Sept. 21, 2010	Aug. 20, 2010	June 25, 2010
Angular diameter (opposition)	3.7	2.4	0.1
Sub-Earth latitude (opposition)	11.3° N	28.5° S	44.6° S
Right ascension (opposition)	23h 56.2m	21h 58.7m	18h 16.7m
Declination (opposition)	-1° 16m	-12° 52m	-18° 15m
Second conjunction date	Mar. 11, 2011	Feb. 17, 2011	Dec. 27, 2010
[a]Data are from the Astronomical Almanac for the years 2007 - 2009			

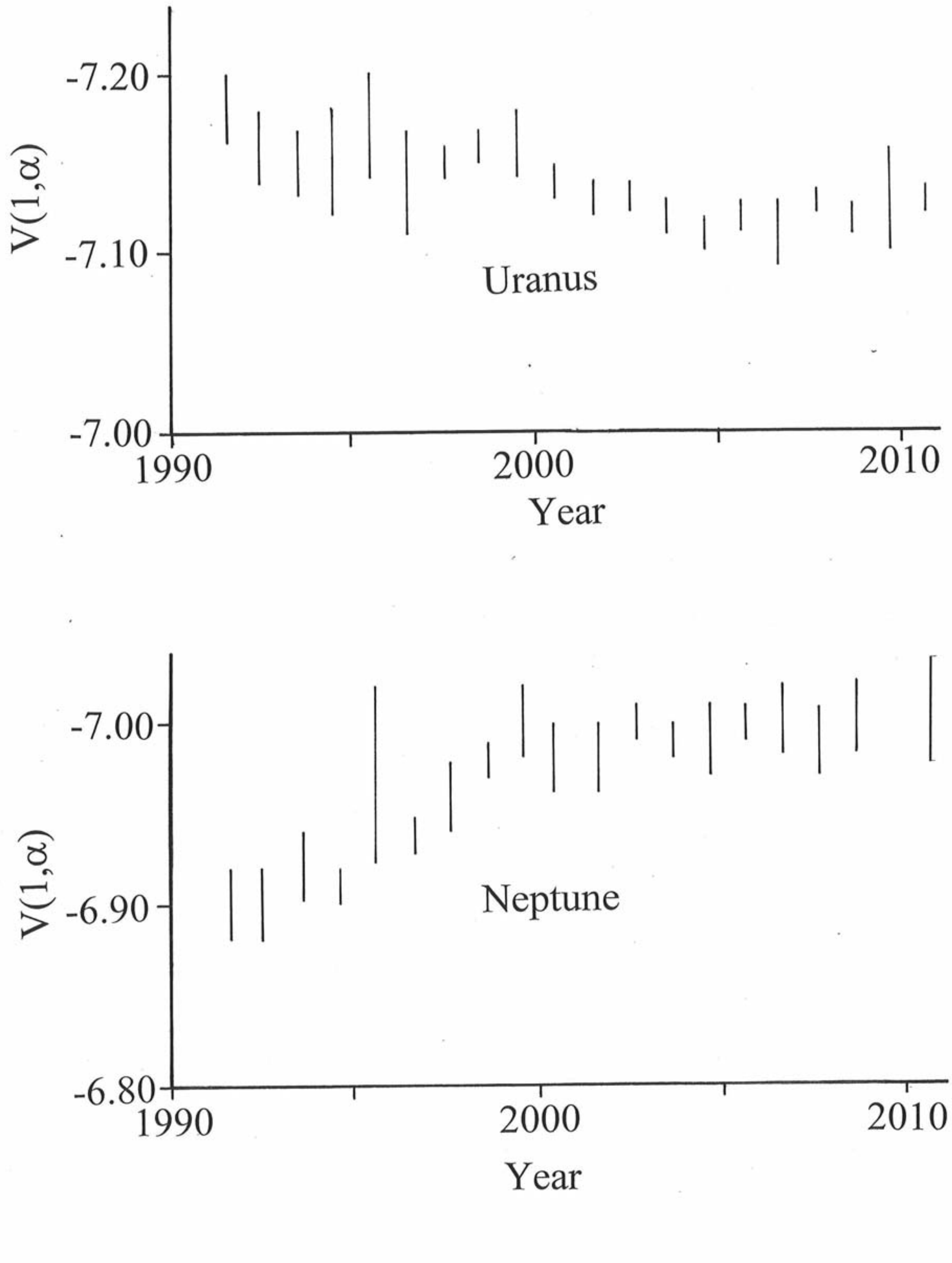


Figure 1. The V(1,a) values for Uranus and Neptune measured since 1991.

Table 2: Contributors to this Report[a]

Name (location)	Type of Observation[b]	Telescope[c]	Name (location)	Type of Observation[b]	Telescope[c]
Patrick Abbott (Canada)	VP	B	Pete Lawrence	I	0.36 m SC
Paul Abel (UK)	D	0.20 m RL	Paul Maxson (AZ, USA)	I	0.25 m Me
David Arditti (UK)	I	0.36 m SC	Detlev Niechoy (Germany)	D, I	0.20 m SC
Norman Boisclair (NY, USA)	DN	0.51 m RL	Damian Peach (UK)	I	0.35 m SC
Brian Combs (GA, USA)	I	0.36 m SC	Christophe Pellier (France)	I	0.25m C
Jim Fox (MN, USA)	PP	0.25 m SC	Phil Plante (OH, USA)	C, D	0.64 m RL
Mario Frassati, Italy	D	0.20 m SC	Carl Roussell (ON, Canada)	C, D, VP	0.15 m RR & B
Richard Hill (AZ, USA)	I	0.13 m SC	Richard Schmude, Jr. (GA, USA)	PP, VP	0.20 m SC & B
Gus Johnson (MD, USA)	Ph P	Camera	George Tarsoudis (Greece)	I	0.25 m RL
Manos Kardasis (Greece)	I	0.28 m SC	Roger Venable (GA, USA)	I	0.36 m SC

[a]The following people contributed valuable observations to the ALPO Japan latest website and are not listed above: Dave and Gail Bleser, Cristina Cellini, Fabrizio Contigliozzi, Marc Delcroix, David Gray, Carlos Hernandez, Toshihiko Ikemura, Akira Kazemoto, Kazuyoshi Maeda, Stauislas Maksymowicz, Satoshi Mogami, Efrain Morales, Pavel Presnyakov, Seiichi Yoneyama and Kenkichi Yunoki. The following observer contributed to the Arkansas Sky Observatory archive: Geoff Chester.

[b]Type of observation: C = Color, D = drawings, DN = descriptive notes, I = images, PP = photoelectric photometry, Ph P = photographic photometry, VP = visual photometry

[c]Telescope: first quantity lists the diameter and the one or two upper case letters lists the type according to: B = binoculars, C = Cassegrain, Me = Mewlon, RL = reflector, RR = refractor and SC = Schmidt-Cassegrain

than the accepted value. There are no stars brighter than magnitude 10 near 21- or 25-Piscium (Sinnott and Perryman, 1997, p. 1279). Therefore, this discrepancy is not due to a nearby star. As a result, an uncertainty of 0.05 magnitudes is reported for the selected B(1,0) value of Uranus.

Jim Fox's comparison star for Neptune, Mu-Capricorni, is listed as a suspected variable (Westfall, 2008). It is not listed as a variable star, however, in Sky Catalogue 2000.0 (Hirshfeld et al, 1991) or in Millennium Star Atlas (Sinnott and Perryman, 1997). Jim's check star for Neptune, Iota-Aquarii, is not listed as a variable star (Westfall, 2008). The average brightness measurement, in stellar magnitudes, for Iota-Aquarii are 4.283 ± 0.003 (V filter) and 4.214 ± 0.003 (B filter). These values are close to the values in Table 3. Because of the good agreement between the measured and accepted brightness values of Iota-Aquarii, the writer concludes that any variability of Mu-Capricorni at the time that the Neptune measurements were made is less than 0.03 magnitudes. An uncertainty of 0.03 magnitudes is reported for the selected B(1,0) and V(1,0) values of Neptune.

Linear fits of V(1,α) and α for Uranus and Neptune to V(1,α) = V(1,0) + cV × α are:

$$V(1,\alpha) = -7.131 - 0.0016\alpha \quad \text{Uranus} \qquad (3)$$

$$V(1,\alpha) = -6.996 - 0.0009\alpha \quad \text{Neptune} \qquad (4)$$

Values of V(1,0) for both planets are close to V(1,α) values. The values of cV, the solar phase angle coefficients, are negative. This is strange and is probably due to the limited accuracy of the values combined with the small range of solar phase angles. Based on previous Earth-based studies, Uranus and Neptune have very low cV values (Schmude, 2008, 17, 62). As in previous studies, the writer assumed that any change in brightness due to the solar phase angle is negligible. Accordingly, the writer reports V(1,α) = V(1,0), B(1,α) = B(1,0) and so forth.

Figure 1 shows the V(1,α) values for Uranus and Neptune measured since 1991. Each apparition average is shown as a line that is equal to the range of the uncertainty. There is a chance that Uranus reached a minimum brightness during its equinox (Meeus, 1997, p. 332) in late 2007 and is starting to brighten again.

Visual Photometry

Patrick Abbott, Phil Plante, Carl Roussell and the writer report brightness estimates of Uranus and Neptune. The selected $\mathbf{V}_{vis}(1,0)$ values for the 2010-2011 apparition are -7.1 (Uranus) and -7.1 (Neptune). These values are based on 65 brightness estimates of Uranus and 36 estimates of Neptune. The value of $V_{vis}(1,0)$ is computed as:

$$V_{vis}(1,0) = V_{mag} - 5.0 \times \log[r \times \Delta] \qquad (5)$$

In this equation V_{mag} is the estimated brightness. The values of r and Δ are defined in equation 1.

Photographic Photometry

Gus Johnson reports the brightness of Uranus as being equal to magnitude 6.3 from photographs. His brightness estimate is close to the expected B filter value.

Drawings and Images

Several people observed and imaged limb darkening on Uranus. Venable did not image any albedo feature on Uranus except for limb darkening in spite of excellent seeing conditions (Figure 2A). The limb darkening was symmetrical. The limb darkening was also symmetrical on August 21, 2010 (Figure 2B). The limb darkening, however, was wider near the southern limb in Frassati's drawing (Figure 2C). The limb darkening was more pronounced in blue light than in red light on July 18, 2010 (figures 2D and 2E).

Several people reported faint albedo irregularities on Uranus. Plante reports that Uranus' preceding hemisphere was brighter than the following one on both September 13 and October 10, 2010. On both dates, he used a 0.64 m (25 inch) reflector. He also

Table 3: Comparison and Check Stars Used in Photometric Studies of Uranus and Neptune

Comparison Star	Brightness (in stellar magnitudes)				Source
	B filter	V filter	R filter	I filter	
21-Piscium	5.99	5.763	—	—	a
25-Piscium	6.265	6.275	—	—	a
Lambda-Piscium	—	4.49	4.30	4.20	b
Mu-Capricorni	5.45	5.08	—	—	c
Iota-Aquarii	4.191	4.266	—	—	a

[a]Westfall (2008) who cites Mermilliod (1991)
[b]Iriarte et al (1965)
[c]Hirshfeld et al (1991)

reports a color difference between the two hemispheres on October 10, 2010. Boisclair reports slight limb darkening with no other albedo features for Uranus on September 18, 2010. He used a 0.51 m (20 inch) reflector under marginal seeing conditions. Abel and Roussell report faint belts on Uranus with 0.2 (8 inch) and 0.15 meter (6 inch) telescopes respectively. McKim and Maksymowicz noted also at least one faint belt (Foulkes, 2011, p. 68). McKim used a 0.41 m (16 inch) Dall-Kirkham telescope and Maksymowicz used a 0.305 m (12 inch) Cassegrain telescope. Gray used a 0.415 m (16 inch) Dall-Kirkham telescope to observe Uranus. He reports faint albedo features on October 24, 2010, December 16, 2010 and January 21, 2011. His drawings are posted on the ALPO Japan latest website: *http:alpo-j.asahikawa-med.ac.jp/indexE.htm*. Maksymowicz posted his images at the same website. He observed faint and variable albedo features on Uranus.

A few 2010 visible light images display Uranus' polar flattening. Any polar flattening in Venable's image is less than 0.01. Pellier's August 21 image shows a polar flattening of between 0.02 and 0.03. Peach's September 27 Uranus images show a polar flattening of 0.02. The images are consistent with a polar flattening of 0.02 ± 0.01.

Peach's September 25, 2010 image of Neptune shows faint albedo features. The most distinct feature is a bright area near the south pole. His image was taken with a 0.35 m (14 inch) Schmidt-Cassegrain telescope with a long-pass red filter. His image is consistent with a polar flattening of about 0.03. This is near the accepted value (Astronomical Almanac, 2009).

Satellites

Delcroix recorded an unfiltered image of Uranus and its four brightest moons on September 19, 2010. He reports brightness values, in stellar magnitudes, of Ariel (13.88), Umbriel (14.36), Titania (13.46) and Oberon (13.80). He also reports a brightness value of 5.7 for Uranus. His Uranus brightness measurement is about 0.1 magnitudes brighter than other V filter measurements made in September 2010. His comparison star, 3UC 178-294705, has a brightness of magnitude 15.7. From these measurements, the writer computes brightness differences (compared to Titania) in stellar magnitudes of: Ariel – Titania = 0.42; Umbriel – Titania = 0.90; Oberon – Titania = 0.34. The value of 0.34 magnitudes for Oberon – Titania is a little high compared to previous results (Schmude, 2010, p. 48). This is consistent with Oberon becoming a little dimmer.

Acknowledgements

The writer is grateful to Truman Boyle for his assistance. He is also grateful to all of the people who submitted observations in 2010-2011.

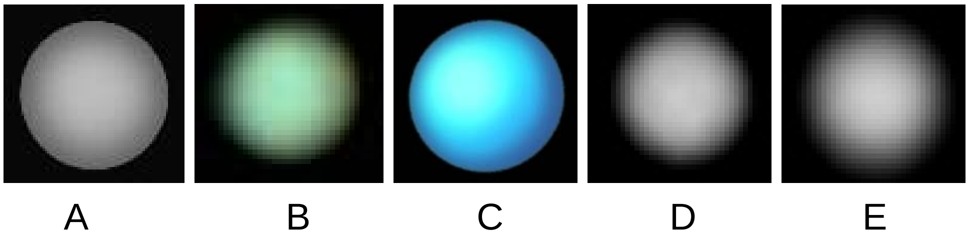


Figure 2. Drawings of Uranus by Venable (A and B) and Frassati (C,D and E).

References

Astronomical Almanac for the Year 2009, Washington DC: US Govt. Printing Office, 2007.

Astronomical Almanac for the Year 2010, Washington DC: US Govt. Printing Office, 2008.

Astronomical Almanac for the Year 2011, Washington DC: US Govt. Printing Office, 2009.

Foulkes M. "Uranus & Neptune: An interim report on the 2010 apparition" Journal of the British Astronomical Association, Vol. 121, No. 2, p. 68, 2011.

Hirshfeld, A., Sinnott, R. W. and Ochsenbein, F. "Sky Catalogue 2000.0, Vol. 1, Stars to Magnitude 8.0" Second Edition, Cambridge MA: Sky Publishing Corp., 1991.

Iriarte, B., Johnson, H. L., Mitchell, R. I. and Wisniewski, W. K. "Five-Color Photometry of Bright Stars" Sky & Telescope magazine, Vol. 30 (July) pp. 21-31, 1965.

Irwin, P. G. J., Teanby, N. A. and Davis, G. R. "Revised vertical cloud structure of Uranus from UKIRT/UIST observations and changes seen during Uranus' Northern Spring Equinox from 2006 to 2008: Application of new methane absorption data and comparison with Neptune" Icarus, Vol. 208, pp. 913-926, 2010.

Karkoschka, E. and Tomasko, M. G. "The haze and methane distributions on Neptune from HST-STIS spectroscopy" Icarus, Vol. 211, pp. 780-797, 2011.

Luszcz-Cook, S. H., de Pater, I., Ádámkovics M. and Hammel H. B. "Seeing double at Neptune's south pole" Icarus, Vol. 208, pp. 938-944, 2010.

Meeus J. "Equinoxes and Solstices on Uranus and Neptune" Journal of the British Astronomical Association, Vol. 107, No. 6, p. 332, 1997.

Mermilliod, J. -C. "Photoelectric Photometric Catalogue of Homogenous Measurements in the UBV System" *NASA, Astronomical Data Center, Selected Astronomical Catalogues. Volume 1*. (CD-ROM), 1991.

Optec, Inc. Model SSP-3 "*Solid-State Stellar Photometer Technical Manual for Theory of Operation and Operating Procedures*" Lowell, MI: Optec, Inc., 1997.

Schmude, R. W. Jr. "*The 1991 Apparition of Uranus*" *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 36, No. 1 (March) pp. 20-22, 1992.

Schmude, R. W. Jr. "*Uranus, Neptune, Pluto and How to Observe Them*." New York: Springer, 2008.

Schmude, R. W. Jr. "*ALPO Observations of the Remote Planets in 2008-2009*" *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 52, No. 2, pp. 43-49, 2010.

Sinnott, R. W. and Perryman, M. A. C. "Millennium Star Atlas" Vol. 2, Cambridge, MA: Sky Publishing Corp., 1997.

Westfall, J. E. "Photometric Catalog of Zodiacal Stars" ALPO Monograph No. 12, 2008.

Table 4: Brightness Measurements of Uranus Made in 2010 and Early 2011

Date	Obs.[a]	Filter	Brightness (magnitudes)[b]		Date	Obs.[a]	Filter	Brightness (magnitudes)[b]	
			Meas. (+)	Normalized (–)				Meas. (+)	Normalized (–)
Sept. 29.202	JF	B	6.36	6.56	Nov. 3.125	JF	V	5.810	7.140
Sept. 29.202	JF	V	5.787	7.133	Nov. 4.130	JF	B	6.40	6.55
Sept. 30.182	JF	B	6.37	6.55	Nov. 4.130	JF	V	5.812	7.139
Sept 30.182	JF	V	5.780	7.140	Nov. 6.102	JF	B	6.40	6.56
Oct. 2.188	JF	B	6.36	6.56	Nov. 6.102	JF	V	5.821	7.133
Oct. 2.188	JF	V	5.789	7.132	Nov. 7.102	JF	B	6.40	6.56
Oct. 7.151	JF	B	6.37	6.55	Nov. 7.102	JF	V	5.824	7.131
Oct. 7.151	JF	V	5.795	7.128	Nov. 7.997	RS	R	6.22	6.74
Oct. 9.167	JF	B	6.37	-6.56	Nov. 8.012	RS	I	7.33	5.63
Oct. 9.167	JF	V	5.791	7.134	Nov. 8.024	RS	R	6.16	6.79
Oct. 10.171	JF	B	6.37	-6.56	Nov. 8.036	RS	I	7.33	5.63
Oct. 10.171	JF	V	5.792	7.133	Nov. 8.050	RS	R	6.18	6.78
Oct. 11.037	RS	V	5.798	7.128	Nov. 17.102	JF	B	6.42	6.56
Oct. 11.054	RS	R	6.14	6.79	Nov. 17.102	JF	V	5.835	7.135
Oct. 11.068	RS	I	7.35	5.58	Nov. 18.134	JF	B	6.42	6.55
Oct 14.164	JF	B	6.38	6.55	Nov. 18.134	JF	V	5.843	7.129
Oct. 14.164	JF	V	5.809	7.120	Dec. 25.098	JF	B	6.48	6.55
Oct. 20.128	JF	B	6.38	6.56	Dec. 25.098	JF	V	5.907	7.132
Oct. 20.128	JF	V	5.810	7.122	Dec. 26.092	JF	B	6.49	6.55
Oct. 23.119	JF	B	6.38	6.55	Dec. 26.092	JF	V	5.913	7.128
Oct. 23.119	JF	V	5.806	7.130	Dec. 29.080	JF	B	6.49	6.55
Oct. 27.098	JF	B	6.39	6.55	Dec. 29.080	JF	V	5.915	7.131
Oct. 27.098	JF	V	5.810	7.131	Jan. 3.067	JF	B	6.50	6.56
Oct. 28.171	JF	B	6.39	6.56	Jan. 3.067	JF	V	5.919	7.136
Oct. 28.171	JF	V	5.807	7.135	Jan. 4.059	JF	B	6.51	6.55
Oct 30.102	JF	B	6.39	6.55	Jan. 4.059	JF	V	5.923	7.134
Oct. 30.102	JF	V	5.807	7.137	Jan. 8.081	JF	B	6.51	6.55
Nov. 2.098	JF	B	6.38	-6.57	Jan 8.081	JF	V	5.929	7.136
Nov. 2.098	JF	V	5.803	7.145	Jan. 14.108	JF	B	6.51	6.56
Nov. 3.125	JF	B	6.39	6.56	Jan. 14.108	JF	V	5.919	7.155

[a]Initials: JF = Jim Fox; RS = Richard Schmude, Jr.

[b]Jim Fox used 21-Piscium as the comparison star and Richard Schmude, Jr. used lambda-Piscium as the comparison star.

Table 5: Brightness Measurements of Neptune Made in 2010

Date	Obs.[a]	Filter	Brightness (magnitudes)[b]		Date	Obs.[a]	Filter	Brightness (magnitudes)	
			Meas. (+)	Normalized (–)				Meas. (+)	Normalized (–)
Aug. 27.197	JF	B	8.10	6.60	Oct. 20.098	JF	V	7.74	6.99
Aug. 27.197	JF	V	7.68	7.02	Oct. 23.091	JF	B	8.12	6.62
Sept. 2.214	JF	B	8.10	6.60	Oct. 23.091	JF	V	7.72	7.02
Sept. 2.214	JF	V	7.69	7.01	Oct. 27.124	JF	B	8.15	6.59
Sept. 25.135	JF	B	8.11	6.61	Oct. 27.124	JF	V	7.73	7.02
Sept. 25.135	JF	V	7.72	6.99	Oct. 28.099	JF	B	8.14	6.61
Sept. 27.107	JF	B	8.12	6.59	Oct. 28.099	JF	V	7.73	7.01
Sept. 27.107	JF	V	7.73	6.99	Oct. 30.059	JF	B	8.14	6.61
Sept. 29.174	JF	B	8.12	6.60	Oct. 30.059	JF	V	7.73	7.02
Sept. 29.174	JF	V	7.70	7.02	Nov. 2.071	JF	B	8.11	6.64
Sept. 30.155	JF	B	8.10	6.62	Nov. 2.071	JF	V	7.75	7.00
Sept. 30.155	JF	V	7.71	7.01	Nov. 3.100	JF	B	8.13	6.63
Oct. 2.158	JF	B	8.14	6.58	Nov. 3.100	JF	V	7.74	7.01
Oct. 2.158	JF	V	7.74	6.98	Nov. 4.102	JF	B	8.15	6.60
Oct. 7.061	RS	V	7.77	6.95	Nov. 4.102	JF	V	7.75	7.01
Oct. 7.126	JF	B	8.13	6.59	Nov. 6.084	JF	B	8.15	6.61
Oct. 7.126	JF	V	7.73	6.99	Nov. 6.084	JF	V	7.74	7.01
Oct. 9.140	JF	B	8.13	6.59	Nov. 7.075	JF	B	8.15	6.61
Oct. 9.140	JF	V	7.73	6.99	Nov. 7.075	JF	V	7.75	7.01
Oct. 10.138	JF	B	8.17	6.56	Nov. 17.072	JF	B	8.15	6.62
Oct. 10.138	JF	V	7.73	7.00	Nov. 17.072	JF	V	7.74	7.03
Oct. 14.138	JF	B	8.12	6.62	Nov. 18.061	JF	B	8.17	6.61
Oct. 14.138	JF	V	7.74	6.99	Nov. 18.061	JF	V	7.75	7.02
Oct. 20.098	JF	B	8.10	6.63					

[a]Initials: JF = Jim Fox; RS = Richard Schmude, Jr.
[b]Jim Fox used mu-Capricorni as the comparison star and Richard Schmude, Jr. used iota-Aquarii as the comparison star

Table 6: Selected Normalized Magnitudes for Uranus and Neptune

Parameter	Planet	Value (stellar magnitudes)	Number of Measurements
B(1,0)	Uranus	-6.56 ± 0.05	26
V(1,0)	Uranus	-7.134 ± 0.009	27
R(1,0)	Uranus	-6.77 ± 0.02	4
I(1,0)	Uranus	-5.61 ± 0.05	3
B(1,0)	Neptune	-6.59 ± 0.03	23
V(1,0)	Neptune	-7.00 ± 0.03	24

ALPO Resources

People, publications, etc., to help our members

Board of Directors

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

- Executive Director; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410
- Member of the Board; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706
- Member of the Board; Donald C. Parker, 12911 Lerida Street, Coral Gables, FL 33156
- Associate Director; Ken Poshedly, 1741 Bruckner Ct., Snellville, GA 30078-2784
- Member of the Board; Mike D. Reynolds, Dean of Mathematics & Natural Sciences, Florida State College, 3939 Roosevelt Blvd, F-112b, Jacksonville, FL 32205
- Member of the Board; Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204
- Member of the Board; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447
- Member of the Board, Secretary/Treasurer; Matthew Will, P.O. Box 13456, Springfield, IL 62791-3456
- Founder/Director Emeritus; Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001

****

Publications Staff

http://www.alpo-astronomy.org

Publisher & Editor-in-Chief

- Ken Poshedly (all papers, submissions, etc); 1741 Bruckner Ct., Snellville, GA 30078-2784

Science / Peer Reviewers

- Klaus R. Brasch; 10915 Sage Rd, Flagstaff, AZ, 86004
- Richard Jakiel; 8620 East Hickory Lane, Lithia Springs, GA 30122
- Roger J. Venable, MD, P.O. Box 117, Chester, GA 31012
- John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447

Book Review Editor

- Robert A. Garfinkle, F.R.A.S., 32924 Monrovia St., Union City, CA 94587-5433

****

Interest Sections

Computing Section

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

- Coordinator; Larry Owens, 4225 Park Brooke Trace, Alpharetta, GA 30022

Historical Section

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

- Coordinator; Richard Baum, 25 Whitchurch Rd., Chester, CH3 5QA, United Kingdom
- Assistant Coordinator; Thomas A. Dobbins, 10029 Colonial Country Club Blvd., Fort Myers, FL 33919

Lunar & Planetary Training Section

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

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

Website

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

- Webmaster; Larry Owens, 4225 Park Brooke Trace, Alpharetta, GA 30022
- Assistant Webmaster; Jonathan D. Slaton, P. O. Box 496, Mansfield, MO. 65704

Youth Section

http://www.cometman.net/youth

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

****

Observing Sections

Solar Section

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

- Coordinator (including all submissions, photo, sketches, filtergrams); Kim Hay, 76 Colebrook Rd, RR #1,Yarker, ON, K0K 3N0 Canada
- Assistant Coordinator; Brad Timerson (e-mail contact only; see listing in *ALPO Staff E-mail Directory* on page 41)
- Assistant Coordinator & Archivist; Jamey Jenkins, 308 West First Street, Homer, Illinois 61849
- Scientific Advisor; Richard Hill, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721

Mercury Section

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

- Coordinator; Frank J. Melillo, 14 Glen-Hollow Dr., E-#16, Holtsville, NY 11742

Venus Section

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

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410

Mercury/Venus Transit Section

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

Coordinator; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447

Lunar Section

Lunar Topographical Studies Program

http://moon.scopesandscapes.com/alpo-topo

Smart-Impact Webpage

http://www.zone-vx.com/alpo-smartimpact.html

The Lunar Observer

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

Lunar Selected Areas Program

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

Banded Craters Program

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

- Coordinator; Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080
- Assistant Coordinator; William Dembowski, 219 Old Bedford Pike, Windber, PA 15963

Lunar Meteoritic Impacts Search Program

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

ALPO Resources

People, publications, etc., to help our members

- 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

Mars Section

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

- Coordinator; Roger J. Venable, MD, 3405 Woodstone Pl., Augusta, GA 30909-1844
- Assistant Coordinator (CCD/Video imaging and specific correspondence with CCD/Video imaging); Donald C. Parker, 12911 Lerida Street, Coral Gables, FL 33156
- Assistant Coordinator (photometry and polarimetry); Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204
- Assistant Coordinator; Jim Melka, 14176 Trailtop Dr., Chesterfield, MO 63017

Minor Planets Section

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

- Coordinator; Frederick Pilcher, 4438 Organ Mesa Loop, Las Cruces, NM 88011
- Assistant Coordinator; Lawrence S. Garrett, 206 River Road, Fairfax, VT 05454
- Scientific Advisor; Steve Larson, Lunar & Planetary Lab, University of Arizona, Tuscon, AZ 85721

Jupiter Section

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

- Coordinator (Section); Richard W. Schmude Jr., 109 Tyus St., Barnesville, GA 30204
- Assistant Coordinator (Section); Ed Grafton, 15411 Greenleaf Lane, Houston, TX 77062
- Assistant Coordinator & Scientific Advisor; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706
- Assistant Coordinator, Transit Timings; John McAnally, 2124 Wooded Acres, Waco, TX 76710
- Assistant Coordinator, Newsletter; Craig MacDougal, 821 Settlers Road, Tampa, FL 33613
- Assistant Coordinator, Eclipses of Galilean Satellites; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447
- Scientific Advisor; Prof. A. Sanchez-Lavega, Dpto. Fisica Aplicada I, E.T.S. Ingenieros, Alda. Urquijo s/n, 48013, Bilbao, Spain wupsalaa@bicc00.bi.ehu.es

Saturn Section

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

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410

Remote Planets Section

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

- Coordinator; Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204

Comets Section

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

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

Meteors Section

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

- Coordinator; Robert D. Lunsford, 1828 Cobblecreek St., Chula Vista, CA 91913-3917
- Assistant Coordinator; Robin Gray, P.O. Box 547, Winnemuca, NV 89446

Meteorites Section

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; Mike D. Reynolds, Dean of Mathematics & Natural Sciences, Florida State College, 3939 Roosevelt Blvd, F-112b, Jacksonville, FL 32205

****

ALPO Publications

The Monograph Series

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

ALPO monographs are publications that we believe will appeal to our members, but which are too lengthy for publication in *The Strolling Astronomer*. All are available online as a pdf files. NONE are available any longer in hard copy format.

There is NO CHARGE for any of the ALPO monographs.

- **Monograph No. 1.** *Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993. 77* pages. File size approx. 5.2 mb.
- **Monograph No. 2**. *Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994. 52* pages. File size approx. 6.0 mb.
- **Monograph No. 3**. *H.P. Wilkins 300-inch Moon Map.* 3rd Edition (1951). Available as one comprehensive file (approx. 48 megabytes) or five section files (Part 1, 11.6 megabytes; Part 2, 11.7 megabytes; Part 3, 10.2 megabytes; Part 4, 7.8 megabytes; Part 5, 6.5 mb)
- **Monograph No. 4.** *Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.127* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere. File size approx. 2.6 mb.
- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.* By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Hard copy $10 for the United States, Canada, and Mexico; $15 elsewhere. File size approx. 2.6 mb.
- **Monograph No. *6.*** *Proceedings of the 47th Convention of the Association of*

ALPO Resources

People, publications, etc., to help our members

Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.20 pages. Hard copy $3 for the United States, Canada, and Mexico; $4 elsewhere.File size approx. 2.6 mb.

- **Monograph No. 7.** *Proceedings of the 48th Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76* pages. Hard copy $12 for the United States, Canada, and Mexico; $16 elsewhere.File size approx. 2.6 mb.

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

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

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

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

ALPO Observing Section Publications

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

- **Solar:** *Guidelines for the Observation of White Light Solar Phenomena*, *Guidelines for the Observing Monochromatic Solar Phenomena* plus various drawing and report forms available for free as pdf file downloads at http://www.alpo-astronomy.org/solarblog.

- **Lunar & Planetary Training Section:** *The Novice Observers Handbook* $15. An introductory text to the training program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. Available as pdf

ALPO Staff E-mail Directory

Online readers please note: Items in blue text in the ALPO Staff E-mail Directory above are links to e-mail addresses. Left-click your mouse on the names in blue text to open your own e-mail program with a blank e-mail preaddressed to the person you chose. Your Internet connection MUST be ON for this feature to work.

Bailey, W .... wayne.bailey@alpo-astronomy.org
Benton, J.L. ....jlbaina@msn.com
Benton, J.L...jlbaina@gmail.com
Brasch, K.R. .... m_brasch@earthlink.net
Baum, R... richard@take27.co.uk
Cook, A. ....tony.cook@alpo-astronomy.org
Cudnik, B...................................... cudnik@sbcglobal.net
Darling, D.O................................. DOD121252@aol.com
Dembowski, W. .... dembowski@zone-vx.com
Dobbins, Tom..............................tomdobbins@gmail.com
Garfinkle, R.A..................................ragarf@earthlink.net
Garrett, L.S. .... atticaowl@yahoo.com
Grafton, E. ....ed@egrafton.com
Gray, R. ....sevenvalleysent@yahoo.com
Haas, W.H.......................................haasw@agavue.com
Hay, K. ....kim@starlightcascade.ca
Hill, D. ....dhill@lpl.arizona.edu
Hill, R...rhill@lpl.arizona.edu
Jakiel, R...rjakiel@earthlink.net
Jenkins, J. .... jenkinsjl@yahoo.com
Kronk, G.................................kronk@cometography.com
Larson, S.................................... slarson@lpl.arizona.edu
Limaye, S.....................................sanjayl@ssec.wisc.edu
Lunsford, R.D.............................. lunro.imo.usa@cox.net
MacDougal, C............................... macdouc@verizon.net
McAnally, J. ....CPAJohnM@aol.com
Melillo, F...frankj12@aol.com
Melka, J. .... jtmelka@yahoo.com
Owens, L.......................larry.owens@alpo-astronomy.org
Parker, D.C................................ park3232@bellsouth.net
Pilcher, F. .... pilcher@ic.edu
Poshedly, K. ....ken.poshedly@alpo-astronomy.org
Reynolds, M. .... mreynold@fscj.edu
Robertson, T.J.........................cometman@cometman.net
Sanchez-Lavega, A................ wupsalaa@bicc00.bi.ehu.es
Schmude, R.W. ....schmude@gdn.edu
Slaton, J.D...jd@justfurfun.org
Timerson, B. .... btimerson@rochester.rr.com
Venable, R.J.......................................rjvmd@hughes.net
Westfall, J.E............................. johnwestfall@comcast.net
Will, M. ....matt.will@alpo-astronomy.org

ALPO Resources

People, publications, etc., to help our members

file via e-mail or send check or money order payable to Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065; e-mail cometman@cometman.net.

- **Lunar (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) observing forms, free at http://moon.scopesandscapes.com/alpo-sap.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-DEEP-SKY (816-333-7759); e-mail leaguesales@astroleague.org. *(2) Observing Forms;* send SASE to obtain one form for you to copy; otherwise send $3.60 to obtain 25 copies (send and make checks payable to "Deborah Hines", see address under "Mars Section").

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

- **Jupiter:** *(1) Jupiter Observer's Handbook*, $15 from the Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail leaguesales@astroleague.org. (2) *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); 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.

ALPO Resources

People, publications, etc., to help our members

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

Other ALPO Publications

Checks must be in U.S. funds, payable to an American bank with bank routing number.

- ***An Introductory Bibliography for Solar System Observers.*** **No charge.** Four-page list of books and magazines about Solar System objects and how to observe them. The current edition was updated in October 1998. Send self-addressed stamped envelope with request to current ALPO Membership Secretary (Matt Will).

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

Back Issues of The Strolling Astronomer

- Download JALPO43-1 thru the latest current issue as a pdf file from the ALPO website at *http://www.alpo-astronomy.org/djalpo* (free; most recent issues are password-protected, contact ALPO membership secretary Matt Will for password info).

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

$4 each:
Vol. 7 (1953), No.10
Vol. 8 (1954), Nos. 7-8
Vol. 11 (1957), Nos. 11-12
Vol. 21 (1968-69), Nos. 3-4 and 7-8
Vol. 23 (1971-72), Nos. 7-8 and 9-10
Vol. 25 (1974-76), Nos. 1-2, 3-4, and 11-12
Vol. 26 (1976-77), Nos. 3-4 and 11-12
Vol. 27 (1977-79), Nos. 3-4 and 7-8
Vol. 31 (1985-86), Nos. 9-10
Vol. 32 (1987-88), Nos. 11-12
Vol. 33 (1989), Nos. 7-9
Vol. 34 (1990), No. 2
Vol. 37 (1993-94), No. 1
Vol. 38 (1994-96), Nos. 1 and 3
Vol. 39 (1996-97), No. 1
Vol. 42 (2000-01), Nos. 1, 3 and 4
Vol. 43 (2001-02), Nos. 1, 2, 3 and 4
Vol. 44 (2002), Nos. 1, 2, 3 and 4
Vol. 45 (2003), Nos. 1, 2 and 3 (no issue 4)
Vol. 46 (2004), Nos. 1, 2, 3 and 4
Vol. 47 (2005), Nos. 1, 2, 3 and 4
Vol. 48 (2006), Nos. 1, 2, 3 and 4
Vol. 49 (2007), Nos. 1, 2, 3 and 4
Vol. 50 (2008), Nos. 1, 2, 3 and 4
Vol. 51 (2009), Nos. 1, 2, 3 and 4
Vol. 52 (2010), Nos. 1, 2, 3 and 4
Vol. 53 (2011), Nos. 1, 2, 3 and 4

$5 ea4h:
Vol. 54 (2012), No. 1 (current issue)

THE ASSOCIATION
OF LUNAR & PLANETARY OBSERVERS (ALPO)

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

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

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

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

Subscription rates and terms are listed below (effective January 1, 2012).

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

- ..$US12 – 4 issues of the digital Journal only, all countries, e-mail address required
- ..$US20 – 8 issues of the digital Journal only, all countries, e-mail address required
- ..$US33 – 4 issues of the paper Journal only, US, Mexico and Canada
- ..$US60 – 8 issues of the paper Journal only, US, Mexico and Canada
- ..$US40 – 4 issues of the paper Journal only, all other countries
- ..$US74 – 8 issues of the paper Journal only, all other countries
- ..$US65 – Sustaining Member level, 4 issues of the digital and paper Journal, all countries
- ..$US130 – Sponsoring Member level, 4 issues of the digital and paper Journal, all countries

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

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

Afterwards, e-mail the ALPO membership secretary at *will008@attglobal.net* with your name, address, the type of membership and amount paid.

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

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

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