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Journal of the Association of Lunar & Planetary Observers

Founded in 1947

The Strolling Astronomer

Volume 49, Number 1, Winter 2007

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Inside. . .

- *The reliability of lunar drawings by Wilkins*
- *Apparition reports on Mercury and Jupiter*
- *Eye position and the brightness of Saturn's rings*
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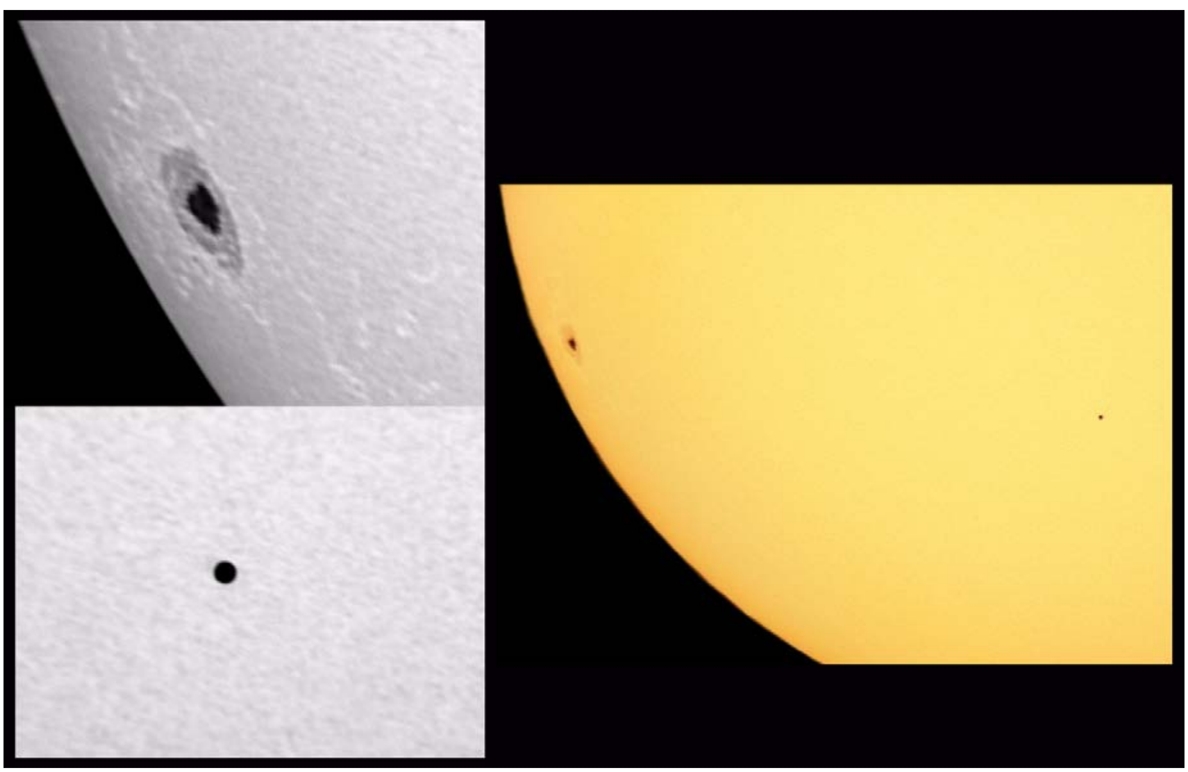
. . . plus reports about your ALPO section activities and much, much more



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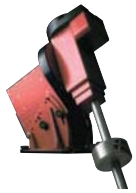

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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 49, No. 1, Winter 2007
This issue published in January 2007 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.

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Visit the ALPO online at:
http://www.lpl.arizona.edu/alpo

Founded in 1947

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Cover Photo: Transit of Mercury as seen Wednesday, November 8, 2006. Images taken by Larry Owens at Mansfield, Georgia USA, using a Celestron C-14 Schmidt-Cassegrain equipped with a Philps ToUcam; software processing done via K3CCD tools; image stacking by Registax. Animation of this image available at http://www.weasner.com/etx/guests/2003/mercury-transit.html

Astronomy Roundup 2007

CALGARY, ALBERTA
JUNE 28 TO JULY 3

YAHOO! The Calgary Centre is hosting the 2007 General Assembly of the Royal Astronomical Society of Canada in conjunction with the Association of Lunar and Planetary Observers' 60th Annual Meeting and the American Association of Variable Star Observers' 96th Spring Meeting.

You don't want to miss it!

To be held on the campus of the University of Calgary, events include optional workshops as well as paper and poster sessions hosted by members of the RASC, ALPO and AAVSO. Optional tours include a visit to the University's Rothney Astrophysical Observatory, a Meteorite Lab and two full-day tours: the Cretaceous/Tertiary Boundary and Tyrrell Museum Badlands tour; and the Looking for Mars in the Canadian Rockies tour.

Keynote speakers include Ray Villard, News Chief from the Space Telescope Science Institute, who will deliver a public lecture entitled "Hubble Space Telescope's Legacy." Our Banquet speaker will be Dr. Eric Donovan who will share his experiences as lead scientist for the Canadian part of the THEMIS project which examines how and why electromagnetic storms (and those beautiful Northern Lights!) are triggered.

So mark June 28 to July 3 on your calendar and plan to attend Astronomy Roundup 2007. This will be a great opportunity to meet and learn from fellow colleagues in the ALPO, the AAVSO and the RASC.

See you in Calgary!
Astronomy Roundup 2007 Organizing Committee

Visit the Astronomy Roundup website to register and for more information on accommodations and events.

http://calgary.rasc.ca/ar2007/

Call for Papers

We invite you to submit a proposal for a paper or a poster to be presented during Astronomy Roundup 2007. The theme of the conference is "Astronomy in Our Backyards," so presentations describing your observing programs and results are particularly apt. Of course, we invite papers and posters from the wide spectrum that is amateur astronomy.

Please submit your proposal
via email (AR2007@shaw.ca)
by March 31.

You will be notified by April 30 if your paper has been accepted as an oral paper or a poster.

Our website has up-to-date information regarding paper and poster sessions and how to submit your abstract. Please consider presenting a paper to share your work and inspire your fellow amateur astronomers.

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Member, section and activity news

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Point of View
Ramblings

By Ken Poshedly, editor & publisher, The Strolling Astronomer

Well, our chosen field of interest, astronomy, has made yet another contribution to mainstream life — but perhaps not quite in the way we'd like. As this is being written in early January 2007, the news is that the 2006 word of the year is (drum roll, please) . . . "plutoed".

Yep, the name of that li'l diminutive body of ice, rock and who-knows-what-else has made its way into mainstream language — at least for awhile.

Its meaning – as you might have guessed – is to be dumped, demoted, relegated unceremoniously to a lower level of importance. Perhaps now, or for the time being, workers everywhere will no longer be downsized, but instead plutoed.

And sadly, two longtime ALPO members have left us and passed on. Denise Nye, described by ALPO's Elizabeth Westfall as "the perfect travel and astronomy partner to long-time ALPO member Derald Nye" left us in March. In her tribute to Denise in JALPO48-2, Ms. Westfall writes: "Denise was recognized as an equal astronomy partner with Derald when the International Astronomy Union (IAU) named asteroid number 3685 DERDENYE for both of them. Derald and Denise visited all the continents and over 90 countries and island groups, and Denise had traveled to 28 total and annular eclipses." The two were about to depart to view her 29th eclipse when she passed away suddenly.

And then only a few short weeks ago, on October 27, ALPO member and heavy-duty contributor Jose Olivarez passed away. Jose worked with former ALPO Lunar Domes Studies Coordinator Harry Jamieson many, many years ago, and later served as the ALPO Jupiter Section coordinator. Jose's most recent volunteer stint was book reviewer for this Journal. His legacy is the much richer knowledge we have about Jupiter, lunar domes and much more. All of us contribute somewhat for the greater good of all, and Jose's contributions are much valued. And while over the years he may not have gotten all things right, Jose did do enough good on this planet that when he left here, he took with him the good wishes and happy thoughts of many of those that he leaves behind. Our sympathies and good wishes go out to his wife, Louise. It is perhaps fitting that – as an astronomy guy to the end – one of his last acts was to prepare his equipment for an observing session at his home in Ocala, Florida.

With Jose now gone, we welcome the able and enthusiastic Bob Garfinkle as acting book reviewer and look forward to his take on books, periodicals and such on solar system astronomy. We assume this means many late-night reading marathons, eh, Bob?

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News of General Interest

Jose Olivarez Remembered

It is with great sadness that we note the sudden passing of longtime ALPO member, former ALPO Jupiter section coordinator and friend to many, Jose Olivarez on the evening of Friday, October 27, at his home in Ocala, Florida, while preparing for an evening observing session.

Announcement of Jose's passing was made via e-mail to various ALPO members by fellow ALPO member and Olivarez family friend, Howard Eskildsen, who was himself notified by Jose's wife, Louise.

A memorial for Jose was held Sunday, November 12, at Ft. King Presbyterian Church in Ocala, where the Olivarez family attended; a star-gazing gathering with invited friends at their residence followed that evening.

As one might expect of a longtime member like Jose, there is no shortage of friends with kind words and remembrances. Although the online tributes were many, here's just a short sampling:

ALPO Founder and Director Emeritus Walter Haas: "It was my good fortune to know Jose Olivarez when he was a high school student at Mission, Texas, in 1959. I was later able to arrange that he received a gift of his first (small) telescope from the Magic Valley Astronomical Society in that part of Texas. When I left there in 1962 to change employment, it is typical that young Jose gave me a treasured book on an astronomical topic.

Jose Olivarez — totally stunned and speechless — at the surprise birthday celebration for him at the ALPO 1994 meeting at Roper Mountain Observatory, Greenville, NC. (Photo courtesy of Jeff Beish)

"I followed his professional career with great interest in the succeeding decades. We once shared a room at an ALPO Convention. I was twice the house guest of him and his gracious wife, Louise, once in Wichita, Kansas, and later when he worked for Chabot at Oakland, California. They were truly perfect hosts. Lunch at a famous Forrest Gump restaurant is among my memories.

"Jose had a large personal astronomical library; and a number of his books are rare collector's items, such as 17th century maps of the Moon. These visits included delightful treats in his home to classical music operas by Wagner and also Gilbert and Sullivan. One may truly wonder how many wives would tolerate telescopes around 10 inches in aperture, and their hefty mounts, in the family living room! We talked of many things, and he certainly had deep religious and spiritual convictions.

"His services to the ALPO and amateur astronomy were many, and the Olivarez blue festoons on the south edge of the North Equatorial Belt of Jupiter should remind us of a kind and gentle man. He gave greatly of himself to others, and he will be greatly missed.

ALPO Executive Director Julius Benton: "Jose was a very special member of the ALPO, serving on our Jupiter Section staff for quite a few years, enjoyed mentoring new observers, and he was an active in training beginners who wanted to do careful visual work on the Jovian planet. Jose was also a connoisseur of fine optics, especially refractors, and enjoyed talking about instrumentation and observing methods. His contributions as our Book Review Editor for many years was deeply appreciated."

ALPO board member and current Jupiter Section Coordinator Richard Schmude: "I first met Jose at the ALCON convention in 1988 in Council Bluffs, Iowa. He gave a talk entitled 'The Wonders of Jupiter'; this talk motivated me to continue my studies of the giant planet Jupiter. I also had the privilege of talking with Jose in March 2005 at his home in Ocala. He was very upbeat about Jupiter studies. We discussed the blue festoon features on Jupiter and he showed me his large refractor. I will truly miss Jose."

ALPO board member Dr. Mike Reynolds: "My mind floods with thoughts about Jose Olivarez. Kind. Passionate. Knowledgeable. Public presence. Gentleman. Friendly.

"Jose was one of those rare individuals who had a passion to share the night skies and astronomy with everyone he met. And in addition, he knew how to inspire – whether verbally, at the telescope, or in

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the written form. An individual who could equally inspire a 7-year-old boy or a seasoned citizen is a rare talent.

"I would often ask Jose to read a chapter here and there for a book I would be writing. His input was always right on the mark! 'Mike, try phrasing this a little differently and see what you think.' I think his understanding of how to write and his written communication skills were exquisite!

"Talk about someone who knew the night sky! Jose's passion was our Solar System, yet he was quite knowledgeable about all aspects of astronomy. Jose's passion was Jupiter and our Moon. A few of you will recall that he was responsible for identifying the 'Olivarez Blue Features' on Jupiter. His ability to record what he saw was phenomenal, too.

"I had the great fortune of working professionally with Jose at the Chabot Space & Science Center in Oakland, California. His vision was clear, and his passion for that vision unparalleled. It was to me truly a wonderful relationship as we set forth on opening the new Science Center. He would teach an adult class in astronomy, which he had done at various institutions. He would memorize his students; an immediate following was created and rightfully so!

"Those who knew Jose could tell you he was a gentleman's gentleman. This I believe was partially rooted in his personal nature as well as his solid Christian beliefs. He also understood what was important in life and had his personal priorities on the right track. He and his wife Louise were truly the perfect couple; Jose could not stand to be separated from her. His love of classical music was a trait you would not be surprised in learning.

"Jose taught me how to make the most-delicious refried beans I have ever eaten! Now this might seem to be an odd comment, but goes to show how he loved to share with others. It wasn't secret or proprietary to Jose; if you were interested, he would willingly share his knowledge with you.

"When I got the word about Jose's passing on an early Saturday morning, the Sun was just rising. It was the beginning of a spectacular day. Yet the sunrise seemed a little muted that day, for we had lost a friend. My regret is that I didn't spend more time with him."

ALPO board member, tireless volunteer and major contributor Don Parker: "It was quite a shock to hear of Jose's passing. He was a fine gentleman. I remember a time several years ago when he and Louise came to Miami from Wichita to visit and observe with Jeff Beish, Bill Douglass and I. It happened that the Southern Cross Astronomical Society (SCAS) had a meeting that week, and we brought Jose along to introduce him to club members. During the meeting, a question about Jupiter came up and Jose was asked his opinion. He reluctantly got up and gave a superb five- or ten-minute talk about the question. After the meeting, a number of people came up to me and asked, 'Where has this guy been — it was great!' That was typical Jose: a man with encyclopedic knowledge who was able to impart it with great clarity and humility.

"Since Jose moved to Florida, he had given a number of presentations to SCAS. Despite the fact that he lived some 400 miles from Miami, he became a semi-regular and very popular speaker at our club.

"Over the years, Jose became a friend to many of us. He was always patient and considerate — especially in answering my stupid questions about Jupiter! Last year, he brought me an astronomy book that he happened across. He remembered that several years ago I had mentioned that I had this book when I was a child and thought I would like a copy! That is typical of Jose's friendship and consideration. He will be missed."

Bob Garfinkle, "Jose had a very wide circle of astronomy friends from his 40 + years association with ALPO, and for me during his tenure on the staff at the Chabot Space and Science Center in Oakland, California. I'm sure we will all miss him."

Former ALPO lunar domes recorder Harry Jamieson: "I knew Jose for many years (he was my first assistant for the Dome Survey back in the early 60s) . . . I'm sorry to hear about his passing. He was a great observer, and an avid collector of rare astronomy books. And . . . he was my friend."

Jeff Beish: "Don Parker called me at Jose's passing and we both took pause, as we have had to do many times in the past and with more frequency these days. I reflected on the years of knowing the gentle Jose. My regret, as well as Mike (Reynolds'), is that I didn't spend more time with him. The last time was at the ALPO meeting in Greenville, SC, in 1994 where the wives prepared for his 50th. birthday surprise — something he was truly surprised at. After moving to Florida, we would e-mail occasionally and always would trade observing experiences. Just a simple relationship between astronomers — our common bond is the heavens.

Reminder: Address changes

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

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

So once again, if you move or change Internet Service Providers and are assigned a new e-mail address, please notify Matt Will at will008@attglobal.net as soon as possible.

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"I first met him in 1980 at an ALPO meeting and we quickly became friends. While he stood out as 'the gentleman' in our company (not hard to do with Chick Capen's 'Black Hole Gang'), we all shared so much in common. He will be missed for sure.

****

Bob Garfinkle has been appointed Acting Book Review Editor effective immediately by ALPO Executive Director Julius Benton following the passing of Jose Olivarez."

RASC 'Astronomy Roundup 2007' Update

The ALPO has accepted an invitation to meet with the Royal Astronomical Society of Canada (RASC) next summer in Calgary, Alberta, Canada. Thes convention has been titled "Astronomy Roundup 2007, Astronomy in Our Backyards", in recognition of the diverse interests in amateur astronomy that will be meeting there. Reflective of this theme, the RASC will also be hosting the American Association of Variable Star Observers (AAVSO) at this meeting, and other astronomical organizations may be represented as well.

This convention is scheduled to commence on Thursday, June 28, 2007, with organizational business meetings in the daytime, and informal gatherings and a tour of Rothney Astrophysical Observatory outside of Calgary in the evening. Paper sessions and workshops begin the next day and run through Sunday, July 1. Two "day-long tour" tours of astronomically-related venues are scheduled for July 2 and 3. The web site to learn of convention details and to register for the convention is: *http://www.calgary.rasc.ca/ar2007/p1.htm*

ALPO staff and members are invited to participate in the paper sessions and workshops at the RASC convention. Plans call for papers to be organized by topic as opposed to organizations having separate paper sessions. So it's possible that separate papers delivered by different organizational staff or members covering similar topics would be scheduled collectively in one time period, for example, in one morning or afternoon.

Advance planning will be crucial to making participation by the ALPO a success. The ALPO asks that abstracts for paper presentations by ALPO volunteer staff and members be submitted to Executive Director Julius Benton no later than March 15, 2007. We know that this is extremely early for ALPO members to plan and submit abstracts, but the ALPO is participating directly in this meeting as opposed to presiding over its own paper session, hence, the need to coordinate early with the convention organizers, the RASC.

Presentations given in this manner lend our organization some prestige in sharing the stage with both the RASC and the AAVSO during this meeting.

Also, attendees flying into Calgary who are U.S. citizens will need to carry a U.S. passport in order to enter Canada and also to return to the U.S. According to the US State Department, this currently only applies to U.S. citizens flying into Canada. Those U.S. citizens traveling by land won't need to carry a U.S. passport until January of 2008. However, there are no guarantees that the U.S. State Department will not invoke this requirement for land travelers sooner in 2007. It is advisable to obtain a U.S. passport regardless of how one enters Canada to insure that entrance into Canada and back to the U.S. goes smoothly. Normally, application for a U.S. passport takes about six weeks.

More information about applying for or updating a U.S. passport can be found on the world wide web at *http://www.travel.state.gov* More reason to plan ahead early for this convention!

The ALPO is looking forward to another successful convention, in Calgary, in '07. We hope to see you there!

ALPO Resources Updates

With new phone numbers, etc, in place, don't forget to refer to the *ALPO Resources* at the back of each Journal before you correspond with any of the ALPO staff or board members. Changes have been made.

ALPO Membership Update

The latest update of ALPO sponsoring memberships, sustaining memberships and our newest members can be found at the end of this section of your Journal.

The ALPO accepts membership payment by credit card via a special arrangement with the Astronomical League. However, in order to renew by this method you MUST have Internet access. See the ALPO membership application form in the ALPO Resources section later in this Journal for details.

ALPO Observing Section Reports

Eclipse Section

Mike Reynolds, coordinator

Visit the ALPO Eclipse Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/eclipse.html*

Meteors Section

Robert Lunsford, coordinator

Report on the 2006 Orionids as seen from the Mojave Desert — This past October, Assistant Meteors Section Coordinator Robin Gray and I ventured to the dark skies of the Mojave Desert to view the Orionid meteor shower. The weather cooperated perfectly, as we did not see a cloud during the entire three days spent in the desert. We make it a point to try to get together at least once a year to view the shower least impacted by the Moon. In 2006, that was the Quadrantids and the

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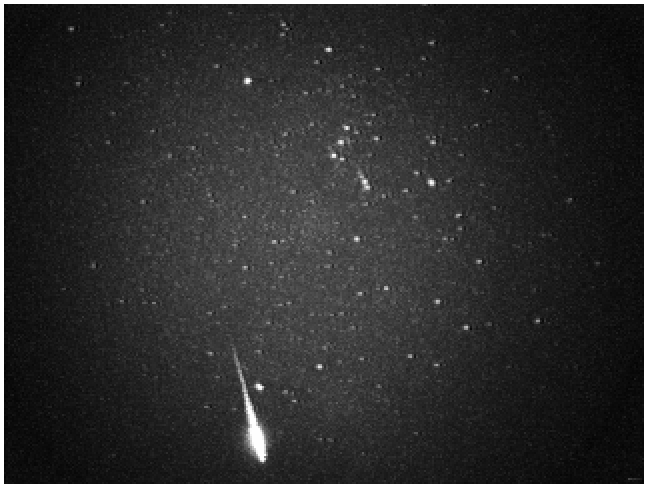

Numerous fireballs were observed during the peak of the 2006 Orionids. Pictured here is a bright Orionid streaking past the bright star Sirius in the constellation of Canis Major. An intensified video camera captured this event at 1010 UT on October 21, during the time of the Orionid maximum activity. The brilliant constellation Orion lies in the upper portion of the frame. The Orionid radiant is located just outside the frame, to the upper left of the bright star Betelgeuse.

Orionids. The Quadrantids of January were not well seen due to low rates, rain, and wind. We both expected a normal display of Orionid activity which provides 20-25 meteors per hour as seen from rural areas. It was evident that during the first night (October 20) that something special was occurring. During the five-hour watch, I counted 97 Orionids, with peak rates of 23 per hour. This was unusually high for the night before the expected peak. The night of maximum activity yielded an astonishing 205 Orionids in five hours with the peak rate of 58. Many of the Orionids were bright and left persistent trains. The final night produced another 171 Orionids during six hours of observing. The three night totals were 473 Orionids seen during 16 hours of observing. This is an average of just under 30 per hour. In 2004, the Orionids produced 97 meteors at maximum during a six-hour watch, an average of 16 per hour.

What caused this unexpected burst of activity? It seems the Earth encountered a higher concentration of material produced by Halley's Comet during one of its previous returns to the inner solar system. The orbit of these particles is different than that of the parent comet. In fact there are many different orbits of meteoroids produced every time Halley's Comet returns to the inner solar system. The exact locations of these orbits are currently unknown; therefore, it is uncertain when the Earth will pass close to another concentrated field of material. The current orbit of Halley's Comet passes no closer than 0.15 astronomical units to the Earth. This is too large of a gap to produce meteor activity. Fortunately there are older orbits that approach much closer to the Earth, producing the Eta Aquarids in May and the Orionids in October.

Our next expedition to the desert will not occur until December 2007 when we will attempt to view the Geminid activity. Hopefully, we will be treated to the same rich display we witnessed this past October!

Visit the ALPO Meteors Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/meteors.html*

Comets Section

Ted Stryk, acting coordinator

The ALPO Comets Section recent observations page has been updated. Images from ALPO contributors can be seen by going to *http://pages.preferred.com/~tedstryk/*

Visit the ALPO Comets Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/comets.html*

Solar Section

Kim Hay, coordinator

The ALPO Solar Section reminds all of its totally revised handbook, The Association of Lunar and Planetary Observers Solar Section - Guidelines for the Observation and Reporting of Solar Phenomena, produced by Jamey Jenkins, assistant coordinator and archivist, and who works with new ALPO solar observers. This new handbook includes up-to-date techniques, many images and links to many solar references. The new handbook is provided as a 58-megabyte file (over 100 pages) in pdf on CD for $10 USD.

To order, send check or US money order made payable to Jamey Jenkins, 308 West First Street, Homer, Illinois 61849; e-mail to jenkinsjl@yahoo.comJoin the Solar Section e-mail group, where you can learn how to observe safely with proper filtering, and how to take images. Go to *http://groups.yahoo.com/group/Solar-ALPO/*

View recently submitted observations on the Web at *http://www.lpl.arizona.edu/~rhill/alpo/solstuff/recobs.html*

Submit all observations to *kim@starlightcascade.ca* .

Visit the ALPO Solar Section on the World Wide Web at *http://www.http://www.lpl.arizona.edu/~rhill/alpo/solar.html*

Mercury Section

Frank J. Melillo, coordinator

Carl Roussell has contributed the most observations of Mercury in 2005. His drawing skills have improved over the last few years and his eyesight is well-trained when it comes to observing fine details on Mercury's surface. The upcoming report on the 2005 Mercury apparitions will feature much of Carl's work.

Looking back over 2006, I've found that many new observers are using webcams,

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which have produced fine images. Unfortunately, however, I have received far fewer observations of Mercury than in previous years and since I became coordinator of this section.

I am hoping for more reports on the November and December 2006 morning apparition to bring up the total amount of observations in 2006.

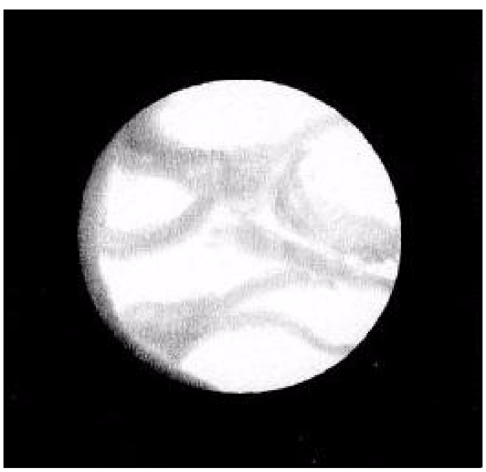
GET OUT AND OBSERVE MERCURY!!

Visit the ALPO Mercury Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/merc.html*

Venus Section

Julius Benton, coordinator

Venus reached conjunction with the Sun on October 27, 2006, ending the 2006 Western (Morning) Apparition. Observational coverage was very good for this observing season, despite the requirement for observers to rise early before sunrise to view or image Venus in the eastern sky. As of this writing (late 2006), the ALPO



Venus, as drawn in integrated light (no filter) by Detlev Niechoy of Göttingen, Germany on 2006 September 17 at 07:32UT using a Celestron 20.3 cm (8.0 in) SCT at 225X. Note the obvious dusky atmospheric features on Venus in the drawing. The planet on this date had an angular diameter of 9.9 arcseconds and a gibbous phase of k = 0.983 (nearly full phase). South is at the top in this image.

Geocentric Phenomena of the 2006-07 Eastern (Evening) Apparition of Venus in Universal Time (UT)

Superior Conjunction	2006	October 27^d UT (angular diameter = 9.7 arcseconds)
Predicted Dichotomy	2007	June 8.65^d (exactly at half-phase predicted)
Greatest Elongation East		June 9^d (Venus will be 45º east of the Sun)
Greatest Brilliancy		July 12^d (m_v = – 4.6)
Inferior Conjunction		August 18^d (angular diameter = 60 arcseconds)

Venus Section has received hundreds of digital images of the planet (many in UV and IR wavelengths), as well as drawings. Analysis of all observations will begin shortly after all data have been collected, and a full report will appear in this Journal.

Venus now appears as a brilliant object in the evening sky right after sunset, and it will begin passage through its waning phases (a gradation from gibbous through crescentic phases), slowly increasing in angular diameter from about 10 arcseconds right after Superior Conjunction (October 27, 2006) to about 60 arcseconds nearing Inferior Conjunction on August 18, 2007. Observers are viewing the leading hemisphere (dusk side) of Venus at the time of sunset on Earth. Observers are always encouraged to try to view Venus as close to the time and date of observations of others (simultaneous observations) in order to improve confidence in results and reduce subjectivity.

The Venus Express (VEX) mission began systematically monitoring Venus at UV, visible (IL) and IR wavelengths in late May 2006. As part of an organized Professional-Amateur (Pro-Am) effort, a few ALPO Venus observers have submitted high quality digital images of the planet taken in the near-UV and near-IR, as well as other wavelengths through polarizing filters. The observations should continue to be contributed in JPEG format to the ALPO Venus Section Coordinator as well as to the VEX website at: *http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856*.

Routine observations of Venus are needed throughout the period that VEX is observing the planet, which continues in 2007 and a few years henceforth, as well as after completion of the mission. Since Venus has a high surface brightness, it is potentially observable anytime it is far enough from the Sun to be seen with threat of eye damage.

Observational Highlights

- 225 digital images of Venus have been submitted.
- 170 drawings and intensity estimates of dusky features suspected on Venus have been received.
- Numerous UV images have shown dusky banded and amorphous atmospheric features
- No instances of dark hemisphere phenomena (e.g., Ashen Light) have been reported
- Pro-Am collaboration in association with the Venus Express (VEX) mission is continuing.
- Incidence of simultaneous observations of Venus is increasing.

Key Observational Pursuits

- Visual observations and drawings in dark, twilight, and daylight skies to look for atmospheric phenomena including dusky shadings and features associated with the cusps of Venus
- Visual photometry and colorimetry of atmospheric features and phenomena
- Monitoring the dark hemisphere for Ashen Light
- Observation of terminator geometry (monitoring any irregularities)
- Studies of Schröter's phase phenomenon near date of predicted dichotomy
- Routine CCD and webcam imaging of Venus at visual, UV, and IR wavelengths

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- Special efforts to accomplish simultaneous observations
- Contribution of observation data and images to the Venus Express mission is encouraged

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

Complete details can be found about all of our observing programs in the ALPO Venus Handbook. Individuals interested in participating in the programs of the ALPO Venus Section are cordially invited to visit the ALPO Venus Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/venus.html*

Lunar Section:

Lunar Topographical Studies / Selected Areas Program

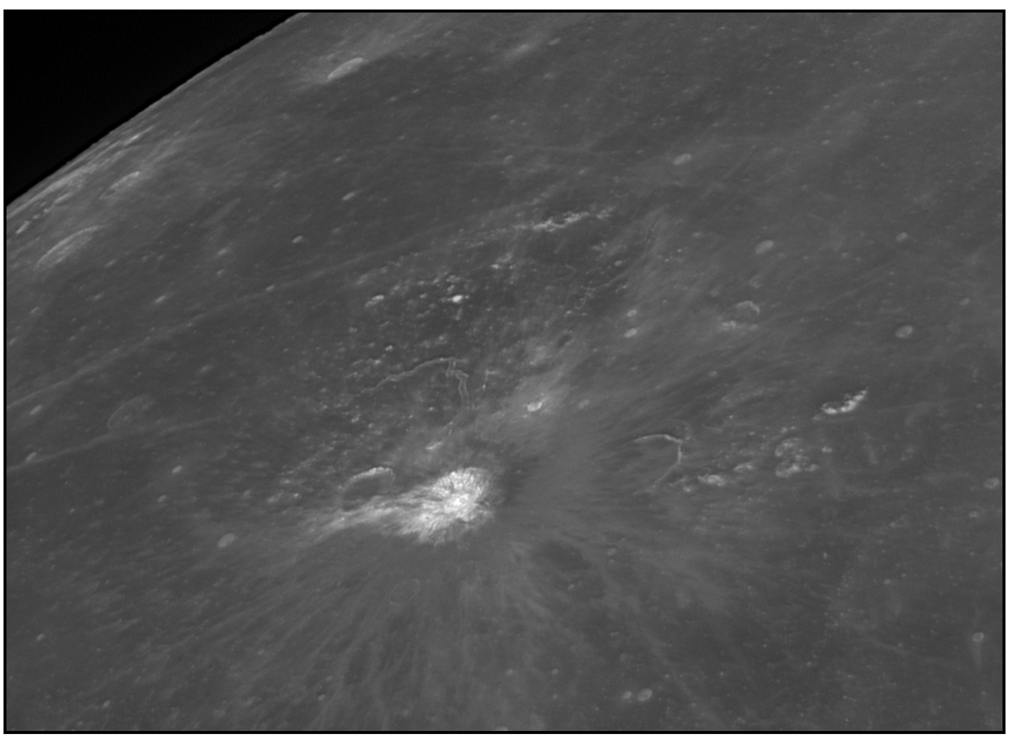
William M. Dembowski, FRAS section coordinator

During an unusually slow third quarter of 2006, the ALPO Lunar Topographical Studies Section (ALPO-LTSS) received 71 new images of the lunar surface from 15 observers in nine countries and five states in the U.S. The LTSS also published reports in the Lunar Section newsletter (*The Lunar Observer*) containing the results of calls-for-observation of Mare Serenitatis and the crater pair of Atlas & Hercules. Participation in both projects was excellent.

In September, a challenge was issued to begin the study of Banded Craters, a Selected Areas Program recently transferred to the Lunar Topographical Studies Section. At this writing (November), four observers have already responded with images and it is hoped that this will mark the beginning of the disciplined and methodical study of these fascinating features using the guidelines established by Dr. Julius Benton, Jr.

Among those responding to the call for Banded Craters was Wayne Bailey (Sewell, New Jersey USA), one of the mainstays of the ALPO-LTSS. Wayne has a PhD in astronomy and, after teaching college level astronomy for several years, worked at NASA for 22 years in support of the Spacelab science missions.

Having started with a Phillips ToUcam Pro 840, his favorite imaging setup now consists of a Celestron 11-inch Ultima SCT with a Taurus Tracker, a Lumenera Skynyx 2-1M monochrome camera, and a near infrared IR72 filter. Although presently concentrating on conventional CCD imaging, Wayne's interest is shifting to the Moon's photometric properties. We await with great interest his progress in this area of lunar research, especially since many of the ALPO-LTSS observing projects involve the study of albedo features.



Digital image of banded crater Aristarchus by Wayne Bailey, Sewell, New Jersey, USA. Image taken October 9, 2006, 06:28 UT, Solar Colongitude 114.5, Seeing 6/10. Equipment: Celestron 11-inch (27.9 cm), f/10 SCT, Schuler IR72 Filter, Lumenera Skynyx 2-1M camera

Visit the following web sites on the World Wide Web for more info:

- ALPO Lunar Topographical Studies Section *http://www.zone-vx.com/alpo_topo.htm*
- ALPO Lunar Selected Areas Program *http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/selarea.html*
- ALPO Lunar Topographical Studies Smart-Impact WebPage *http://www.zone-vx.com/alpo-smartimpact.html*
- *The Lunar Observer* *http://www.zone-vx.com/tlo.pdf*

Lunar Dome Survey

Marvin Huddleston, FRAS, coordinator

Lunar Dome Survey Mission Statement

The ALPO Lunar Dome Survey exists to further the serious study of selenology, the science lunar astronomy. In particular, our purpose is to establish an organized outlet for serious students of this science as it relates to the study of volcanic lunar domes.

Our aim is to contribute to our knowledge of selenology through an organized and detailed examination of these features. The first phase of the survey was to discover and catalog these illusive features, an effort which was completed many years ago.

The primary goal of the present effort is to take this existing catalog of more than 700 objects and to make it a valuable and useful scientific tool, as well as make an effort to create a digital catalog (photo library) of these features.

This will be accomplished by confirming the domes in the catalog and removing those which do not meet the criteria of confirmation. A certificate program is being designed which will be used as a training platform for current and future observers. Interested participants will observe a selected listing of the "best" of the current catalog, earning a certificate in the process. An advanced certificate is also planned.

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Lunar Calendar, January thru March 2007

Date	Time (UT)	Event
Jan. 03	13:57	Full Moon
Jan. 06	19:00	Moon 0.88 Degrees NE of Saturn
Jan. 10	16:25	Moon at Apogee (404,335 km - 251,242 miles)
Jan. 11	12:44	Last Quarter
Jan. 15	15:00	Moon 5.8 Degrees S of Jupiter
Jan. 17	02:00	Moon 4.5 Degrees S of Mars
Jan. 19	19:00	Moon 1.2 Degrees SSE of Mercury
Jan. 19	19:04	New Moon (Start of Lunation 1040)
Jan. 20	15:00	Moon 2.2 Degrees SSE of Neptune
Jan. 20	18:00	Moon 0.73 Degrees SE of Venus
Jan. 22	05:00	Moon 0.44 Degrees WNW of Uranus
Jan. 22	12:00	Moon at Perigee (366,925 km - 227,997 miles)
Jan. 25	23:02	First Quarter
Feb. 02	05:45	Full Moon
Feb. 07	12:40	Moon at Apogee (404,989 km - 251,649 miles)
Feb. 10	09:51	Last Quarter
Feb. 12	09:00	Moon 6.0 Degrees S of Jupiter
Feb. 15	03:00	Moon 3.5 Degrees SSE of Mars
Feb. 17	02:00	Moon 2.1 Degrees SSE of Neptune
Feb. 17	16:14	New Moon (Start of Lunation 1041)
Feb. 18	09:00	Moon 3.9 Degrees SSE of Mercury
Feb. 18	17:00	Moon 0.59 Degrees N of Uranus
Feb. 19	09:35	Moon at Perigee (361,439 km - 224,588 miles)
Feb. 19	16:00	Moon 2.2 Degrees NNW of Venus
Feb. 24	07:56	First Quarter
Mar. 02	02:00	Moon 1.0 Degrees NNE of Saturn
Mar. 03	23:17	Full Moon (Total Lunar Eclipse)
Mar. 07	03:38	Moon at Apogee (405,850 km - 252,184 miles)
Mar. 11	23:00	Moon 6.0 Degrees S of Jupiter
Mar. 12	03:35	Last Quarter
Mar. 16	02:00	Moon 1.7 Degrees SSE of Mars
Mar. 16	15:00	Moon 2.0 Degrees SSE of Neptune
Mar. 17	04:00	Moon 1.3 Degrees SSE of Mercury
Mar. 18	06:00	Moon 0.72 Degrees NW of Uranus
Mar. 19	02:43	New Moon (Start of Lunation 1042)
Mar. 19	18:40	Moon at Perigee (357,815 km - 222,366 miles)
Mar. 21	12:00	Moon 3.7 Degrees NNW of Venus
Mar. 25	18:16	First Quarter
Mar. 29	05:00	Moon 1.1 Degrees NNE of Saturn

(Table courtesy of William Dembowski)

Currently, of the 700+ objects in the catalog, many remain unconfirmed. The majority of the objects in the catalog have not been properly studied or classified. Many of the objects in the catalog may not even be true lunar domes, but rather hills and other geological features which may resemble domes.

While we will continue to encourage submission of drawings of the features under scrutiny, a new emphasis will be placed on recording these features under various solar illuminations using digital photography (either CCD cameras or webcams). In addition, astronomers with access to photoelectric photometers are encouraged to submit observations of the albedo changes associated with the areas under study.

Participants are encouraged to contact Harry D. Jamieson, e-mail *hjamieson@telocity.com* in order to obtain a copy of the Lunar Observers Tool Kit, (Windows edition).

Visit the ALPO Lunar Dome Survey on the World Wide Web at *http://www.geocities.com/kc5lei/lunar_dome.html*

Lunar Transient Phenomena
Dr Anthony Cook, coordinator

Visit the ALPO Lunar Transient Phenomena program on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/ltp.html and http://www.ltpresearch.org/*

Lunar Meteoritic Impact Search
Brian Cudnik, coordinator

Information on impact-related events can be found at *http://www.i2i.pvamu.edu/physics/lunimpacts.htm*

Visit the ALPO Lunar Meteoritic Impact Search site on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/lunimpacts*

Mars Section
Dan Troiani, coordinator & Daniel P. Joyce, assistant coordinator

As you read this, the 2007 apparition of Mars will have already begun. CCD imaging has already started, but visual drawings have to wait until Mars reaches 6 arc seconds in June 2007. This being an “aphelic” apparition, Mars will not be as close to Earth as it was in 2005; however, for observers in Earth's northern

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hemisphere, Mars will be approximately 11° higher in our sky which will help our seeing conditions.

The fact that Mars will be just about as far north as possible during an opposition this time is somewhat offset by its slow progress to that status, as it is now very far south and will be very unfavorably positioned until almost April.

If you are interested in seeing and talking to other Mars observers from around the world in real time then please sign up to the Yahoo club called “marsobservers”. This is a small group for serious telescopic observers of Mars exclusively, as it has no discussion of the Mars rovers, nor any general discussion of Mars except as an object for telescopic observation and imaging. It is a great place to keep up with activity on the red planet. Go to *http://tech.groups.yahoo.com/group/marsobservers/?yguid=158883981*

With Mars getting closer you may want to check out the article “Observing the Planets with Color Filters”, available online at *http://www.lpl.arizona.edu/~rhill/alpo/marstuff/articles/filter1.htm* Color filters can help you see things on Mars that you may pass over otherwise; they help overcome image deterioration caused by atmospheric scattering of light, they permit separation of light from different levels in a planetary atmosphere, they increase hue contrast between areas of differing color, and they reduce irradiation within the observer's eye. All of these factors increase the sharpness of details in the atmosphere that are seen on the planet Mars.

Visit the ALPO Mars Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/mars.html*

Minor Planets Section

Frederick Pilcher, coordinator

Pluto now has an official designation as minor planet number 134340. However the ALPO Minor Planets Section considers Pluto to be the responsibility of the ALPO Remote Planets Section to which any research on Pluto should be forwarded. The *Minor Planet Bulletin* has never published a paper on Pluto.

Lightcurves of 56 different minor planets have been published in *Minor Planet Bulletin* Vol. 34, No. 1, 2007 January-March. Most but not all of these have yielded definitive synodic rotation periods and amplitudes. Some are redeterminations for minor planets with previously published periods for which the new observations constitute progress toward a shape model and spin vector determination. Included are minor planets numbers 122, 217, 562, 601, 631, 670, 685, 894, 972, 1110, 1273, 1293, 1318, 1355, 1456, 1493, 1495, 1720, 2083, 2131, 2150, 2222, 2294, 2393, 2510, 3015, 3089, 3115, 3155, 3353, 3853, 3872, 3913, 5841, 6255, 6382, 6046, 6410, 6500, 6790, 7169, 8290, 9298, 9387, 9566, 9739, 11574, 13070, 20452, 22722, 40559, 42923, 45263, 108846, 2001 FY92, and 2006 NM.

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Lawrence Garrett, assistant coordinator

Greetings MAP Observers and ALPO Staff:

A look ahead to 2007 highlights this 10 year anniversary edition of the ALPO Minor Planet Section MAP Alerts. Holiday greetings and a Happy New Year to ALL.

Adding to Prof. Frederick Pilcher's close approach objects for 2007, 1882 Apollo, 3200 Phaethon, and 4954 Eric, is the bright Apollo asteroid 2006 VV2.

About 15 degrees from the Moon (one day before full) on April 1, this object peaks at Mv 9.9, moving at 55 arc minutes per hour due south. Indeed, on March 27, this will be placed just 5 degrees from Polaris at Mv 13.0, moving to -38 degrees by April 5, Mv 11.9. A vivid example of a close approach flyby for sure. I plan to bring this rare opportunity to the attention of Spaceweather.com as well as the general ALPO membership. While not very close in terms of lunar distances, about a dozen at best, this is an excellent spring target for all observers and imagers.

Also coming on 2007 will be Gerard Faure's 10 year complete review of observations for our entire observing history, and even before! While not a ALPO staff member, his efforts at both the computer and telescope have made such a large impact on this program, who needs to crash probes into comets! From his world class mountain observing site, he can reach down to magnitude 16.0 using just a Celestron 8. His dedication at the computer is equally matched. So we await his final report, and once again I thank Gerard for his tireless work.

Thanks also go out to all readers of not only these alerts, but also my other publications since 1988, the Near-Earth Asteroids Bulletin, and America Online's “Asteroids Online”, which lead to the Magnitude Alert Program. More then 1000 personal messages over this time have truly blessed me with friends very much J.U.Gunter had under his project “Tonight's Asteroids” did.

I wish to thank Vishnu Reddy for his advice on asteroid discovery, I found 2!

I wish to thank for Brian Warner for his advice and help since 1988.

I wish to thank Prof. Pilcher for his help for since my first asteroid observations for the ALPO in 1977.

Lastly, I thank Dr. Richard Binzel for his help in getting the Magnitude Program started 10 years ago!

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

In addition, please visit the ALPO Minor Planets Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/minplan.html*

Jupiter Section

Richard W. Schmude, Jr., coordinator

Having reviewed the several hundred images of Jupiter received during the 2005-2006 apparition, the main highlights of this apparition were:

- The merging of at least two white ovals in the NEB
- The narrowing of the SEB
- The continuation of oval BA to remain red until at least August 2006
- The overtaking of the Great Red Spot by oval BA last summer

The north temperate belt has remained faint during the entire apparition. As of Oct. 14, 2006, the SEB was still dark and visible. It may be growing weak and for this reason, we will need observations of it as soon as Jupiter emerges in the morning sky in late December.

Visit the ALPO Jupiter Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/jup.html*

Galilean Satellite Eclipse Timing Program

John Westfall, Jupiter Section assistant coordinator

On 2006 Nov 21 UT, Jupiter passed behind the Sun (or pretty close), ending the 2005-2006 Apparition and beginning the 2006-2007 one. Of course, one can't observe Jupiter or its

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satellites when too near the Sun; but by early 2007 Jan, the planet should be high enough above the pre-dawn horizon that one could start timing the eclipses of its four major (Galilean) satellites.

The 2006-2007 Jupiter Apparition runs from 2006 Nov 21 to 2007 Dec 23, with opposition to the Sun on 2007 June 05. This apparition finds the planet well south of the celestial equator (declination –21°.9 at opposition). The Earth continues south of Jupiter's equator (approximately the same as the orbital planes of the Galilean satellites), so eclipses of the Galilean satellites will appear to us to take place south of the center of the planet's disk, particularly so for Ganymede. (Callisto continues uneclipsed; its next eclipse by Jupiter is not scheduled to take place until 2008 Jan 09.)

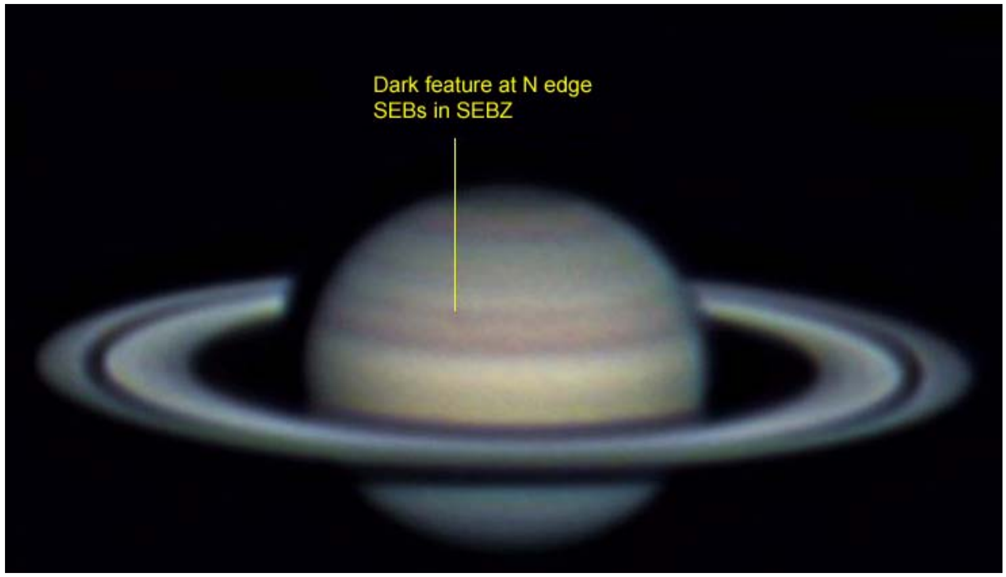
In 2007 March, an unusual type of eclipse event takes place: the visibility from Earth of the disappearance and reappearance of Europa for the same eclipse. This will happen on 2007 March 06, 10, 13 and 17. On each of those dates, Europa will undergo a 2.5-hour eclipse followed, in about 1 minute, by a 2.5-hour occultation by Jupiter. It clearly will be an observational challenge to spot Europa's brief reappearance on Jupiter's limb. The last time Europa's disappearance and reappearance for the same eclipse was visible was on 2001 March 04. The reason we've had to wait five years for a repeat is that the phenomenon requires that Jupiter be near quadrature (90° from the Sun) at the same time that the Earth is over about 3° from Jupiter's equator.

For current participants in our program, this is the time to send in your eclipse timings for the late apparition, if you have not done so already. New and potential observers are invited to contact the writer (*johnwestfall@comcast.net* or P.O. Box 2447, Antioch, CA 94531-2447 USA) to obtain an observer's kit, which includes Galilean satellite eclipse predictions for 2007. Note that this is one of our least technology-intensive programs – it involves visual timing of the beginning and end of the eclipses by Jupiter of its major satellites, using telescopes of 2.25-in. (60-mm) aperture on up. (There is, admittedly, a minor need for electronics, in that you need a time source accurate to one second, such as an "atomic" watch or clock or a GPS receiver.)

Saturn Section

Julius Benton, coordinator

The 2006-07 observing season is well underway with roughly 60 digital images and drawings of the planet having arrived by the time of this writing. Saturn now appears in the eastern sky before sunrise, progressively increasing in western elongation; it will reach opposition on 2007 February 10th when it will be well-placed for observing for most of the night. During this apparition, the southern hemisphere and south face of the rings are visible from Earth, but portions of the northern hemisphere of Saturn can also be glimpsed now that the tilt of the rings to our line of sight has diminished to roughly -14°.



Excellent view of Saturn with diffuse dusky features emanating from the N edge of the SEBs into the SEBZ in this image taken by Ralf Vandebergh of Maastricht, The Netherlands, on 2006 November 07 at 05:46UT, using a 25.4 cm (10.1 in) Newtonian with a Philips ToUcam digital imager with RGB filters. CMI = 81.4º, CMII = 154.6º, and CM III = 311.5º. South is at the top in this image.

Observational Highlights for the 2006-07 Apparition (as of early November 2006):

- 35 digital images of Saturn have been submitted.
- 25 drawings and intensity estimates of Saturn have arrived.
- Several small, very elusive white mottlings have been suspected in the EZs.
- Several tiny, transient dark features were imaged in the SEBZ, emanating from the N edge of the SEBs.
- Pro-Am collaboration in association with the Cassini Mission is continuing in 2006-07.
- Incidence of simultaneous observations of Saturn steadily increased during this observing season.

Activities of the ALPO Saturn Section this apparition

- Visual numerical relative intensity estimates of belts, zones, and ring components.
- Full-disc drawings of the globe and rings using standard ALPO observing forms.
- Central meridian (CM) transit timings of details in belts and zones on Saturn's globe.
- Latitude estimates or filar micrometer measurements of belts and zones on Saturn.
- Colorimetry and absolute color estimates of globe and ring features.
- Observation of "intensity minima" in the rings, plus studies of Cassini's, Encke's, and Keeler's divisions.
- Systematic color filter observations of the bicolored aspect of the rings and azimuthal brightness asymmetries around the circumference of Ring A. (See paper by Roger Venable on this topic later in this issue.)
- Observations of stellar occultations by Saturn's globe and rings.

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Geocentric Phenomena for the 2006-2007 Apparition of Saturn in Universal Time (UT)	
Conjunction	2006 Aug 07^d UT
Opposition	2007 Feb 10^d
Conjunction	2007 Aug 21^d
Opposition Data:	
Equatorial Diameter Globe	20.2 arcseconds
Polar Diameter Globe	18.0 arcseconds
Major Axis of Rings	45.8 arcseconds
Minor Axis of Rings	11.0 arcseconds
Visual Magnitude (m_v)	$-0.0m_v$ (in Leo)
B =	$-13.8°$

- Visual observations and magnitude estimates of Saturn's satellites.
- Multi-color photometry and spectroscopy of Titan at 940nm - 1000nm.
- Regular imaging of Saturn and its satellites using webcams, digital and video cameras, and CCD cameras.

For 2006-07, imagers are urged to carry out simultaneous visual observations of Saturn on the same night and as close as possible to the same time images are taken. All observers should make comparisons of what can be seen visually vs. what is apparent on their images, without overlooking opportunities to make visual numerical intensity estimates using techniques as described in the author's new book, *Saturn and How to Observe It*, available from Springer, Amazon.com, etc.

Furthermore, the Saturn Pro-Am effort began back on 2004 Apr 01 when the Cassini probe started observing the planet at close range; observers are encouraged to participate in this effort as the Cassini mission continues during the 2006-07 apparition and beyond. Using classical broadband filters (Johnson UBVRI system) on telescopes with suggested apertures of 31.8 cm (12.5 in.) or more, observers should image Saturn through a 890nm narrow band methane (CH_4) filter.

Observers should image Saturn every possible clear night in search of individual features, their motions and morphology. Resulting data serve as input to the Cassini imaging system, thereby suggesting where interesting (large-scale) targets exist. Suspected changes in belt and zone reflectivity (i.e., intensity) and color will be also useful, so visual observers can play a vital role by making careful visual numerical relative intensity estimates in Integrated Light (no filter) and with color filters of known transmission.

The Cassini team will combine ALPO images with data from the Hubble Space Telescope and from professional ground-based observatories. Observations should be immediately dispatched to the ALPO Saturn Section throughout the 2006, 2007, and 2008 apparitions for immediate dispatch to the Cassini team.

The ALPO Saturn Section is grateful for the work of so many dedicated observers who take the time to send us observations and images. Our efforts have prompted more and more professional astronomers to request drawings, images, and supporting data from amateur observers and imagers worldwide.

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn pages on the official ALPO Website at *http://www.lpl.arizona.edu/~rhill/alpo/sat.html*

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

Remote Planets Section

Richard W. Schmude, Jr., coordinator

Approximately 25 people submitted observations of the remote planets (Uranus, Neptune and Pluto) in 2006. If you have not yet submitted your own observing reports on these objects, please do so as soon as possible so they can be included in the 2006 apparition report now being compiled.

Uranus will still be visible during January and early February of 2007 before it passes behind the Sun in March. Likewise, Neptune will be visible for only a few days in early January before it approaches the glow of the Sun and passes behind it in February.

Also, there will be several important mutual events of Uranus' moons in late 2007. There will be more details on these events in the Remote Planets Review which will be distributed in June 2007.

Visit the ALPO Remote Planets Section on the World Wide Web at *http://www.lpl.arizona.edu/~rhill/alpo/remplan.html*

ALPO Interest Section Reports

Computing Section

Kim Hay, coordinator

Visit the ALPO Computing Section on the World Wide Web at: *http://www.lpl.arizona.edu/~rhill/alpo/computer.html*

Lunar & Planetary Training Program

Tim Robertson, coordinator

For information on the ALPO Lunar & Planetary Training Program on the World Wide Web, go to *http://www.cometman.net/alpo/*; regular mail to Tim Robertson at 2010 Hillgate Way #L, Simi Valley CA, 93065; e-mail to *cometman@cometman.net*

Instruments Section

R.B. Minton, coordinator

Visit the ALPO Instruments Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/inst.html and *http://mypeoplepc.com/members/patminton/astrometric_observatory/*

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Membership Update — Sponsors, Sustaining Members, and Newest Members

By Matthew L. Will, ALPO membership secretary/treasurer

The ALPO wishes to thank the following members listed below for voluntarily paying higher dues. The extra income helps in maintaining the quality of the ALPO Journal while helping to keep the overall cost of the Journal in check. Thank you!

SPONSORS (as of 11/15/06) - Members giving $120 or more per membership

Sponsor	City	State
Dr Julius L Benton, Jr	Savannah	GA
Henry “Hank” Bulger	Grants	NM
Kurt Casby	Saint Paul	MN
Craig Counterman	Wakefield	MA
William Dembowski	Windber	PA
Leland A Dolan	Houston	TX
Robert A Garfinkle, FRAS	Union City	CA
Roy A Kaelin	Flossmoor	IL
Gregory Macievic	Camden	OH
John W Mc Anally	Waco	TX
Donald C Parker	Coral Gables	FL
Cecil C Post	Las Cruces	NM
Berton & Janet Stevens	Las Cruces	NM
Roger J Venable	Augusta	GA
Gerald Watson	Cary	NC
Matthew Will	Springfield	IL
Christopher C Will	Springfield	IL
Thomas R Williams	Houston	TX

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS ALPO Founded in 1947

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SUSTAINING MEMBERS (11/15/06) - Members giving $60 per membership...

Sustaining Member	City	State	Country
Stephen Beckwith	Bolton	MA	
Raffaello Braga	Milano		Italy
Klaus R Brasch	Highland	CA	
Charles L Calia	Ridgefield	CT	
Eugene W Cross, Jr	Fremont	CA	
Thomas Deboisblanc	Westlake Village	CA	
Mike Dillon	Minneapolis	MN	
Nicholas Eftimiades	Silver Spring	MD	
T Wesley Erickson	Warner Springs	CA	
Howard Eskildsen	Ocala	FL	
Denis Fell	Edmonton	AB	Canada
Bill Flanagan	Houston	TX	
Geoff Gaherty	Coldwater	ON	Canada
Gordon Garcia	Bartlett	IL	
Robin Gray	Winnemucca	NV	
David M Griffee	Indianapolis	IN	
Steven E Haugen	St Petersburg	FL	
Dr John M Hill, Ph D	Tucson	AZ	
Mike Hood	Kathleen	GA	
Vince Laman	Laguna Niguel	CA	
James (Jim) S Lamm	Charlotte	NC	
David J Lehman	Fresno	CA	
June C Loertscher	Janesville	WI	
Robert Maxey	Summit	MS	
Robert O'Connell	Keystone Heights	FL	
Matthew Paine	Brockton	MA	
Dr Arthur K Parizek	Rio Verde	AZ	
R Brad Perry	Yorktown	VA	
Anthony Portoni	Benton	AK	
Mike D Reynolds	Jacksonville	FL	
Tim Robertson	Simi Valley	CA	
Takeshi Sato	Hatsukaichi City	Hiroshima	Japan
Mark L Schmidt	Racine	WI	
Lee M Smojver	Tukwila	WA	
Robert Stock	Drexel Hill	PA	
Miami Valley Astronomical Society	Dayton	OH	
Gary K Walker	Macon	GA	
Joel Warren	Amarillo	TX	
Russell Wheeler	Edmond	OK	

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NEWEST MEMBERS...

The ALPO wishes a warm welcome to those who recently became members. Listed below are persons that have become new members from January 16, 2006 through November 15, 2006, including their locations and their interests in lunar and planetary astronomy. Welcome aboard!

Member	City	State	Country	Interests
Ethan Allen	Sebastopol	Ca	USA	
Theodore Arambatzoglou	Kallithea		Greece	
Rick Backhus	Seward	Ne	USA	
Harold Baird	Fort Worth	Tx	USA	
Thomas Bash	Jim Thorpe	Pa	USA	
Stephen Michael Bieger	Chamblee	Ga	USA	
Richard Blaisdell	Au Sable Forks	Ny	USA	
David Buikema	Lockport	Il	USA	
John M Candy	Whitley Bay		United Kingdom	0
Tom Coombs	Lake Worth	Fl	USA	
Delwin Croom	Hampton	Va	USA	
Mitchell Diers	Turlock	Ca	USA	
Claude Duplessis	Laval	Qc	Canada	012456789
Alfred Fantegrossi	Windham	Nh	USA	56
Doug Faron	Shohomish	Wa	USA	
Steven I Feiertag	Royal Palm Beach	Fl	USA	
Gerald Flaherty	Plymouth	Ma	USA	
Bill Flanagan	Houston	Tx	USA	0456CDS
Marc Eduard Frincu	Timisoara		Romania	
David E Furry	Broomfield	Co	USA	3456
Russell Merle Genet	Santa Margarita	Ca	USA	
John Hansen	Carrollton	Ga	USA	045
Kaj Hansen	Carrollton	Ga	USA	05
Gordon Houston	Houston	Tx	USA	
Martin Ingen	Geldermalsen		Netherlands	
Tom Johnson	Santa Maria	Ca	USA	
Sam Kimpton	Portland	Or	USA	3ACHM
Roger Laureys	Hasselt		Belgium	
Kathrine F Manizade, Phd	Salisbury	Md	USA	3
James J Martin	Fort Myers	Fl	USA	
Jim Melka	Chesterfield	Mo	USA	
Mrs Rosemary Minsky	Nuevo	Ca	USA	
Toshirou Mishina	Yokohama	Na	Japan	023456IPS
Oswaldo Perin	Houston	Tx	USA	
Scott Prior	Qualicum	Bc	Canada	05
Stuart Riley	Gardner	Ks	USA	
Bradley Rutz	New Tripoli	Pa	USA	
Jeffery Sandel	Cayce	Sc	USA	03456M
Franco Sgueglia	Lesmo	Mi	Italy	
Steven Taylor	Germantown	Md	USA	
James E Taylor	Southfield	Mi	USA	
Pete Thompson	Gainsville	Ga	USA	
Joe Ulowetz	Northbrook	Il	USA	4
Gary K Walker	Macon	Ga	USA	3456HI
Russell Wheeler	Edmond	Ok	USA	0356A

Interest Code 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
H = History
I = Instruments
M = Meteors
O = Meteorites
P = Photography
R = Radio Astronomy
S = Astronomical Software
T = Tutoring

Feature Story:

Index to Volume 46 of The Strolling Astronomer

By Michael Mattei
E-mail: *micmattei@comcast.net*

Publication Data

Issue Number:

1, Winter 2004 .... pp. 1-44
2, Spring 2004...................... pp. 1-40
3, Summer 2004 .... pp. 1-48
4, Autumn 2004 .... pp. 1-60

Author Index

Subject Index

Book Review:
Collins Atlas of the Night Sky

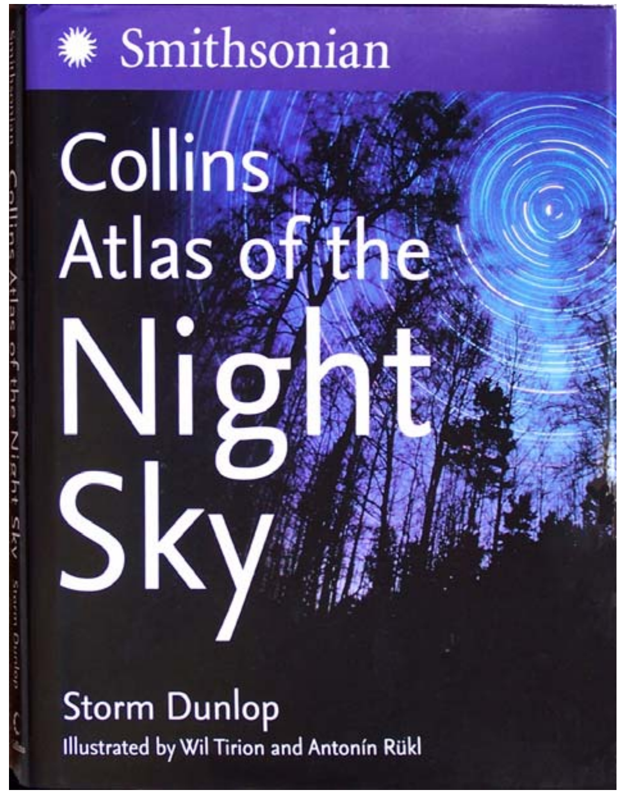
By Howard Eskildsen

Collins Atlas of the Night Sky
by Storm Dunlop
Illustrated by Wil Tirion & Antonin Rukl
224 Pages
HarperCollins Publishing, New York, New York, 2005
Price: $29.95 Hard Cover
ISBN-10:0-06-081891-3 (United States)
ISBN-13:978-0-06-81891-3

Storm Dunlop has produced a no-nonsense sky atlas that is geared for the observer, offering him beautifully illustrated star charts, exquisite lunar charts, and planetary locator diagrams for 2006 through 2010. First, it breezes through an eight-page introduction that will familiarize the beginner with basics of coordinates, stellar properties and a concise review of clusters, nebulae and galaxies. Illustrations clarify concepts and help the reader visualize the information. The short introduction then quickly gives way to the book's primary purpose as an observer's atlas.

Twenty charts cover the complete night sky, showing stars down to magnitude 6.5. The layout allows the user to view the chart on the right page with accompanying data on the left so that the chart and data can be viewed together without having to turn pages. The information tables cover defining data on variable stars, double and multiple stars, clusters, nebulae and galaxies. The main charts locate nearly every deep sky object worth viewing, including some beyond the reach of most amateur telescopes. A brief look at the legend-key to the main atlas charts makes it easy for the reader to locate double stars, variable stars, and to distinguish between the various types of deep sky objects and estimate their sizes.

Next, the atlas covers each of the 88 constellations with stars charted to magnitude 7.5. Another legend-key for the constellation charts is included on the first chart for easy object reference. A quick glance at the chart for Andromeda reveals three Messier objects, two open clusters, a planetary nebula and several NGC galaxies. Their relative sizes are immediately apparent. The accompanying text describes seven multiple star systems, all three of the Messier objects and four of the NGC objects. A description of the constellation and significant events associated with it is also provided. Again, the layout makes for easy cross reference from chart to text and back, making this excellent atlas a dream to use.



The lunar atlas, exquisitely drawn by Antonin Rukl and beautifully printed in this book, surpasses the high standard set by the star charts. A four-page introduction covers the basics of phases, libration and lunar coordinates, along with an explanation of the change in coordinate convention in 1961. Lunar features such as maria, highlands, rilles and rays are discussed, and properties of simple craters, complex craters and impact basins are covered. Sixteen charts cover the face of the Moon and four more charts show the libration zones. Though on a smaller scale, the very high quality of the charts equals — if not surpasses — Rukl's *Atlas of the Moon*. The layout displays an 8.5-by-8.5 inch upright map on the left page and a smaller, nearly 6-inch square, left/right reversed map on the opposite page, with text describing significant features on each section. (This left/right reversal is for the benefit of those who use with cassegrains and refractors equipped with star diagonals, or any other set up with an odd number of reflective surfaces.)

A small, handy locator chart shows at a glance the location of the section on the lunar disk. A table shows best age of the Moon to view prominent features and translations of some of the Latin names. An index at the back of the book lists all lunar features shown on the charts. At the end of the lunar section, whole-disk images of the near side and far side of the Moon show 30 confirmed impact basins, and the outline of the hypothetical Procellarum basin.

The final section of the book covers solar system objects with the usual brief introduction dealing with orbital motions, planetary properties, and significant events such as conjunctions, elongations, transits of Venus and Mercury and opposition dates. Diagrams and photos illustrate surface features on Mars, Jupiter and Saturn. Asteroids, comets and meteors are briefly mentioned, and a table lists the major meteor showers and dates. Charts show the locations of Mars, Jupiter, Saturn, Uranus and Neptune from 2006 through 2010. Other charts show the New Moon and Full Moon, plus the times that Mercury and Venus are visible in twilight/darkness for latitudes 60, 50 and 40 degrees north as well as for 35 degrees south.

Without a doubt, this is a terrific atlas for the active observer. The included lunar atlas by Rukl alone is worth the price of the book. I have had my copy for several months and use it regularly. Its observer-friendly layout, excellent charts and well-printed illustrations make it an ideal reference for anyone who observes the stars, Moon or planets.

Feature Story:
The 2006 Transit of Mercury: A Pre-Report

By: John E. Westfall, coordinator, ALPO Mercury/Venus Transit
E-mail: *johnwestfall@comcast.net*

The transit of the planet Mercury across the face of the Sun on November 8-9, 2006, was widely observed throughout its zone of visibility. As of this writing (about four weeks after the event), the ALPO Mercury/Venus Transit Section has received reports from 22 individuals or groups spread from Australia to Venezuela, with the majority in North America. Results are still coming in, with instruments so far ranging from 10x50 binoculars to a 16-inch reflector, while forms of observation consist of drawings, digital still photographs, video sequences, written notes and timings of the four transit contacts.

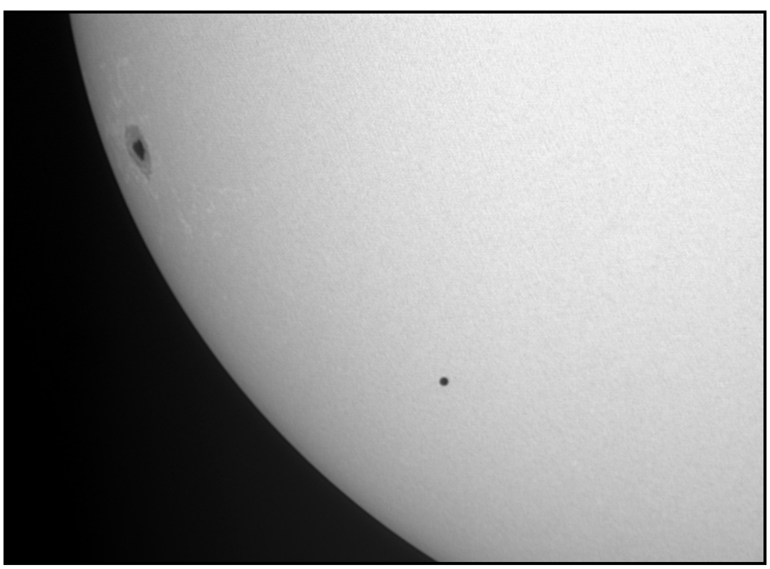
Because the transit was centered over the Pacific basin, most observers could watch only some of the five-hour event. The Sun set before the emersion of Mercury from the Sun for those in most of North and South America, but they still were able to observe the planet's immersion.

Whether at immersion or emersion, some observers noted the famous "black drop" effect, but others did not. As one would expect, given Mercury's 10 arc-second disk, nobody could see the planet without magnification. Although Mercury did not pass across, or even near, any sunspot, a medium-sized spot (in Active Region 10923) had recently rotated onto the Sun's (celestial) eastern limb. Some observers, prior to first transit contact, initially thought the spot was the planet Mercury, but soon were convinced otherwise when the much-smaller planet came into view. The comparative aspect of the planet and the spot is well shown in a video image here Edward Lomeli.

Naturally, what we have received is a small fraction of the undoubtedly thousands of observations of the transit that were made. Besides those made by amateurs, observations were made at professional observatories such as the Swedish Solar Telescope at Las Palmas in the Canary Islands; the Mees Solar Observatory at Haleakala, Hawaii; the 150-foot solar tower on Mount Wilson; the McMath-Pierce Solar Telescope at Kitt Peak National Observatory, Arizona; the Dunn Solar Telescope at the Sacramento Peak Observatory, New Mexico; and the Chile, California, Hawaii and Australia stations of the GONG network. As is becoming standard procedure for planetary transits, satellites also recorded the event – in this case, the Japanese HINODE and the American SOHO and TRACE satellites.

Many transit observations are available on the World Wide Web. Among many others, we recommend looking at Jay Pasachoff's site (*http://www.williams.edu/astronomy/eclipse*) and the Spaceweather.com site (*http://www.spaceweather.com/eclipses/gallery_08nov06.htm*).

A number of ALPO members have posted their observations on their own websites. But unfortunately, due to permissions issues, this by itself does not constitute submitting them to this section to be placed in our upcoming report. If you would like to see your transit observations mentioned in print, please either give us permission to download them from your website and reproduce them, or simply send them to us directly. Naturally, if you have made Mercury transit observations, we welcome them for inclusion in our report. This is particularly true for contact timings, where the significance of our analysis will only increase with the number of observations.



Video image of the November 8-9, 2006, transit of Mercury. Taken by Ed Lomeli of Sacramento, California, USA with a 4-inch (101 mm), f/8 Astrophysics refractor at prime focus. Recorded at 19:47:52 UT on November 8, about 35 minutes after the beginning of the transit. North is at the top, Mercury is below center and moving to the right, while the sunspot in Active Group 10923 is in the upper left of this image.

All Readers

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

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Feature Story:

Mercury Apparition Observations in 2004

By Frank J Melillo, coordinator, ALPO Mercury Section
E-mail: *frankj12@aol.com*

Abstract

There were seven apparitions of Mercury in 2004. As usual, these varied widely in their visibility due to the obliquity and eccentricity of Mercury's orbit. There was a slight increase in the number of observers and observations as compared to earlier recent years. Many albedo features were described, and these often showed good correlation with the albedo chart prepared by Murray, Smith, and Dollfus.

Introduction

The characteristics of the seven apparitions of Mercury that occurred in 2004 are listed in Table 1. A total of 15 observers submitted 94 observations, which is a slight increase compared to recent years (Melillo, 2002, 2005a, 2005b). There were 55 drawings, 10 CCD images, and 29 webcam images made using apertures from 9.0 to 25.4 cm (3.5 to 10 in.).

Observers from both northern and southern latitudes participated, filling gaps where one hemisphere was more favored than the other (Table 2). There were a number of independent simultaneous observations. The availability of technology such as fine optics, CCD and webcam imaging devices, color filters, and Internet communications, has not only improved the quality of observations but has made it more fun to observe Mercury than ever before. It is exciting that ALPO observers now are consistently documenting albedo features where no detail was seen by most observers for many years.

ALPO observations reported in this paper are correlated with the Mercury surface map made by Murray, Smith, and Dollfus (Murray, Smith, and Dollfus, 1972). Readers who do not have access to that publication will do well by correlating the observations to the map prepared by Mario Frassati and recently published in two places (Melillo, 2006, and Melillo, 2004).

While we were making these observations in 2004, NASA launched its Messenger spacecraft to Mercury. If all goes well, it will arrive at that planet in March 2011. The long duration of the trip is due to a looping flight path that took it past Earth on a flyby in August 2005, flybys of Venus in October 2006 and June 2007, and flybys of Mercury in January and October of 2008, and September 2009, before finally settling into orbit around that planet. We hope that the ALPO Mercury section can make a good albedo map before this spacecraft upstages us!

Table 1: Characteristics of the Apparitions of Mercury in 2004 (all dates UT)

Number and Type	Beginning Conjunction*	Greatest Elongation	Final Conjunction*	Aphelion	Perihelion
1. Morning	Dec 27, 2003 (i)	Jan 17	Mar 4 (s)	Feb 6	-----
2. Evening	Mar 4 (s)	Mar 29	Apr 17 (i)	------	Mar 21
3. Morning	Apr 17 (i)	May 14	Jun 18 (s)	May 4	------
4. Evening	Jun 19 (s)	Jul 27	Aug 23 (i)	Jul 31	Jun 17
5. Morning	Aug 24 (i)	Sept 9	Oct. 5 (s)	-----	Sept. 13
6. Evening	Oct. 6 (s)	Nov. 21	Dec 10 (i)	Oct 27	------
7. Morning	Dec. 10 (i)	Dec 29	Feb. 14, 2005 (s)	------	Dec 10
* (i) = inferior conjunction, (s) = superior conjunction					

All Readers

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

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In the 2004 April issue of *Discover* magazine, a leading article was published about Mercury for which this author provided the information (Guterl, 2004). Concerning that article, Dr. Ann Sprague of the Lunar and Planetary Laboratory said, "It is the most substantial information about Mercury ever supplied to the public" (personal communication, 2004). In addition, this author provided an article for *Sky & Telescope* magazine covering the favorable morning apparition of September 2004, which is also described here (Melillo, 2004). It is hoped that these articles will inspire more readers to observe this tiny planet.

Apparition 1: (Morning) 27 Dec 2003 – 4 Mar 2004

After the inferior conjunction of Dec 27, 2003, four northern hemisphere observers braved the morning chill to observe Mercury, together with one observer from Australia. It was a moderately favorable apparition for observers in both hemispheres. Cudnik and Roussell made drawings on Jan 10 (CM = 276°) when Mercury was a fat crescent of 45 percent illumination. In both drawings, a shaded area is evident along the northern part of

Table 2: ALPO Observers of Mercury 2004

Observer	Location	Instrument*	No. & Type of Observations **	Apparition Observed
Michael Amato	West Haven, CT USA	10.4 cm RR	2 D	1, 2
Brian Cudnik	Houston, TX USA	25.4 cm NT	15 D	1,2,3,5,7
Mario Frassati	Crescentino, Italy	20.3 cm SCT	15 D	2,4,6,7
Walter Haas	Las Cruces, NM USA	20.3 NT	4 D	2
Steve Massey	Sydney Australia	24.5 cm NT	3 W	4,6
Poalo Lazzarotti	Messa, Italy	Planewton L252	2 W	4
Ed Lomeli	Sacremento, CA USA	23.5 cm SCT	4 W	5,7
Frank J Melillo	Holtsville, NY USA	20.3 cm SCT	9 CCD	2,5,7
Detlev Niechoy	Gottingen, Germany	20.3 cm SCT	5 D	2
Ricardo Nunes	Libson, Portugal	20.3 cm SCT	1 W	2
Tizrano Olivetti	Bangkok, Thailand	180mm Mak Cass	1 CCD	7
Carl Roussell	Hamilton, Ontario Canada	15 cm RL	14 D	1,2,4,5,7
Erwin V D Velden	Brisbane, Australia	23.5 cm SCT	7 W	1,3,6
Tim Wilson	Jefferson City, MO USA	9.0 cm RR	7 W	2,5,7
Christian Wohler	Heroldstatt, Germany	20 cm NT	5 W	2,5

NOTE : *NT = Newtonian, RL = Reflector, RR = Refractor, SCT = Schmidt-Cassegrain
**CCD = CCD imaging, D = Drawing, W = Webcam

the terminator, which is likely Solitudo Aphrodites. This is a large dark albedo feature on the IAU map, centered at about 285° longitude. On Jan 11 (CM = 282°), Amato drew a large northern-hemisphere dark area centered on about 303° longitude (Figure 1A).

On Jan 16 and 17 (CM = 308 and 314°, respectively) with Mercury near its greatest elongation of 24° west, Roussell drew the planet and noted faint details (Figure 1B). The phase was already at 63% illumination, though it was a day before greatest elongation (see Figure 8). On Jan 17 (CM = 316°), van der Velden made a webcam image in unusually good conditions. It revealed faint details, especially the white area Pieria in the SE part of the disk. Cudnik and Wilson observed Mercury on Jan. 18, 19 and 20 (CM = 319°, 324° and 329°, respectively) and noted shadings along the terminator. Wilson's drawing of the 19th is Figure 1C. Van der Velden's webcam image on Jan 21 (CM = 336°) showed a possible white area near the center of the terminator, again near Pieria (Figure 1D). Pieria is believed to be a crater with bright ejecta documented by radar observation in 2001 (Beatty, 2002).

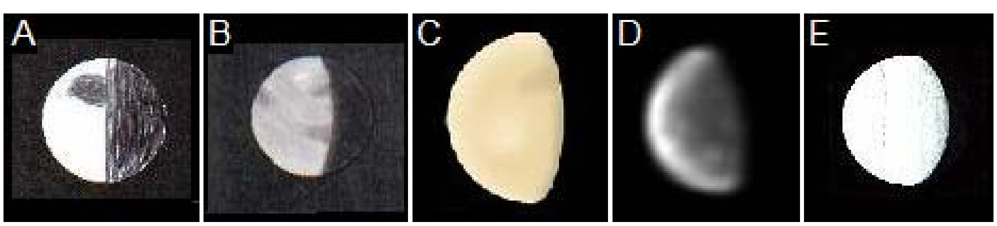

Figure 1: Images from apparition 1. North is up and celestial east is to the left. A. Drawing by Michael Amato, 11 Jan 2004 12:00 UT, CM = 282°. B. Drawing by Carl Roussell, 16 Jan 2004 12:20 UT, CM = 308°. C. Drawing by Tim Wilson, 19 Jan 2004 13:00 UT, CM = 324°. D. Webcam image by Erwin van der Velden, 21 Jan 2004 20:15 UT, CM = 336°. E. Drawing by Brian Cudnik, 27 Jan 2004 13:25 UT, CM = 003°.

Roussell drew a white area in the same region on Jan 22 (CM = 339°). Van der Velden made his last image on Jan 25 (CM = 356°) which showed the white Pieria area again, but nearer to the terminator. It also showed another bright area near the SE limb which might be the ejecta of a crater imaged by Mariner 10, called Kuiper.

Final drawings by Cudnik and Roussell were made Jan 25, 27 and 28 (CM = 353, 003 and 008°, respectively) and revealed shaded markings along the terminator (Figure 1E). Mercury reached superior conjunction on Mar 4.

Apparition 2: (Evening) 4 Mar – 17 Apr

While spring was coming to Earth's northern hemisphere, Mercury made a fine appearance in the evening sky. It was seen by 10 observers, and this was the largest contribution of the year. Mercury reached perihelion on March 21.

On March 7, Wilson became the first observer of this apparition when he drew the planet at an elongation of only 4° (CM=185°). That drawing and another he made on Mar 15 (CM = 218°; Figure 2A) show faint details in the southern hemisphere that are probably Solitudo Helii and Solitudo Atlantis. Also on March 15, Frassati drew a dark area where Solitudo Atlantis is located. Some fine webcam images taken by Wohler on March 16 and 17 (CM = 220° and 224°, respectively) show features which are hard to correlate with the standard albedo features.

On March 18 (CM = 227°), Haas drew spotty details along the terminator. On March 22 and 23 (CM=244° and 249°, respectively) Wilson, Cudnik, Roussell and Melillo reported albedo features in the southern hemisphere (Figure 2B, 2C, and 2D). The most prominent of the detected southern features is probably Solitudo Criophori. This same area was probably detected by Amato, Niechoy, Roussell and Wolher on March 28 and 29 (CM=273° and 278°) in the southern hemisphere (Figure 2F).

Mercury reached its greatest elongation on March 29 when just 44% illuminated. An area of most interest was near to 280° longi-

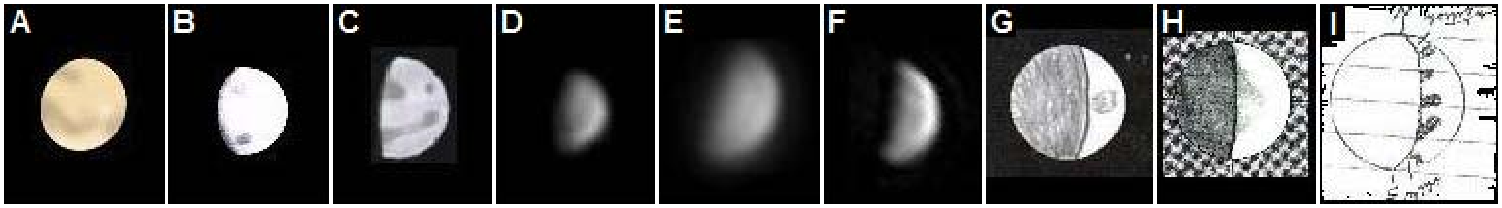

Figure 2: Images from apparition 2. North is up and celestial east is to the left. A. Drawing by Tim Wilson, 15 Mar 2004 0:30 UT, CM = 218°. B. Drawing by Brian Cudnik, 22 Mar 2004 0:45 UT, CM = 244°. C. Drawing by Carl Roussell, 22 Mar 2004 23:52 UT, CM = 244°. D. CCD image by Frank Melillo, 23 Mar 2004 19:00 UT, CM = 249°. E. Webcam image by Ricardo Nuñes, 25 Mar 2004 17:30 UT, CM = 259°. F. Webcam image by Christian Wohler, 28 Mar 2004 17:45 UT, CM = 273°. G. Drawing by Michael Amato, 29 Mar 2004 23:45 UT, CM = 278°. H. Drawing by Detlev Niechoy, 30 Mar 2004 18:21 UT, CM = 284°. I. Drawing by Walter Haas, 31 Mar 2004 1:55 UT, CM = 291°.

tude and north of the equator. It was seen well in past apparitions but did not reveal itself this time. Perhaps it can be seen better at some angles of position and phase than at others. As the phase narrowed, Amato, Cudnik, Haas, Niechoy and Wohler continued to observe Mercury, but details were elusive. On April 17, Mercury went through inferior conjunction.

Apparition 3: (Morning) 17 Apr – 18 Jun

This apparition was much more favorable for viewers in Earth's southern hemisphere. Only five observations were received, all from Cudnik and van der Velden. Cudnik made two drawings despite the difficulty of the apparition for the northern hemisphere observers.

Mercury reached its greatest elongation on May 14. Van der Velden made images with a webcam on May 17 and 20 (CM=220° and 235°, respectively). In both images it is difficult to identify albedo features. His image from May 17 is Figure 3A. But Cudnik's drawing on May 23 (CM=247°), shows a possible Solitudo Criophori along the terminator combined with Solitude Alarum extending toward the northeast limb (Figure 3B). On the same day, van der Velden made an image showing a possible dark area where Solitudo Criophori is located, together with an extension toward the northeast terminator consistent with Solitudo Alarum (Figure 3C).

On May 27 (CM=266°), Cudnik drew a dark area just south of the equator on the terminator, and this, too, may be Solitudo Criophori (Figure 3D). Mercury reached superior conjunction on June 18.

Apparition 4: (Evening) 18 Jun – 23 Aug

Despite summer weather, a moderately favorable apparition, and an evening presentation, only six observations were received from northern hemisphere observers. Although Mercury's altitude was highest in the sunset glow as seen from the southern hemisphere, only one observation was made by southern observers.

Roussell observed Mercury on July 7 and 10 (CM = 75° and 88°, respectively) and drew the planet with faint albedo features, of which the southern one appears to be Solitudo Martis near the terminator (Figure 4A). Frassati also drew this marking on July 14 (CM=110°).

On both July 20 and 21 (CM's 138° to 144°), Lazzarotti and Massey both made webcam images that may show light and dark areas in the southern hemisphere, but they are quite subtle (Figure 4B and 4C). Frassati made a drawing on July 24 (CM = 157°) that probably shows Solitudo Jovis and Helii in the southern hemisphere and Solitudo Neptuni in the North (Figure 4D). Lazzarotti made a final image on July 28 (CM = 177°). Mercury passed through inferior conjunction on August 23.

Apparition 5: (Morning) 23 Aug – 5 Oct

This was perhaps the best apparition of the year. In spite of the article about observing Mercury in the *Sky & Telescope* September

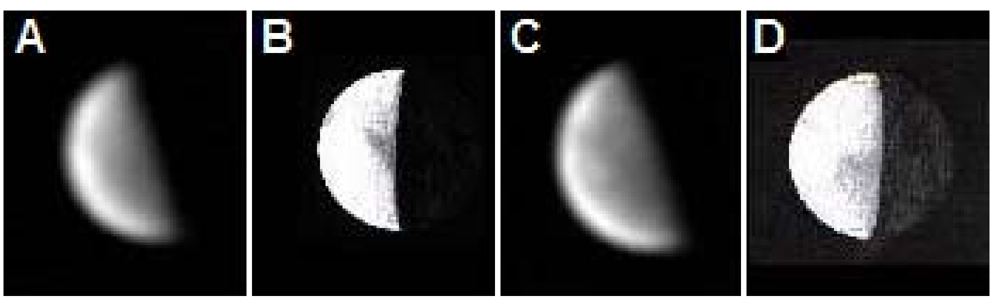

Figure 3: Images from apparition 3. North is up and celestial east is to the left. A. Webcam image by Erwin van der Velden, 17 May 2004 20:37 UT, CM = 220°. B. Drawing by Brian Cudnik, 23 May 2004 11:15 UT, CM = 247°. C. Webcam image by Erwin van der Velden, 23 May 2004 21:26 UT, CM = 249°. D. Drawing by Brian Cudnik, 27 May 2004 11:15 UT, CM = 266°.

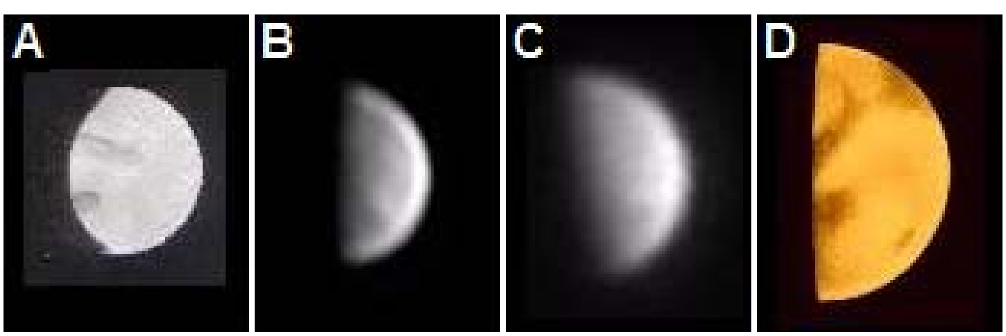

Figure 4: Images from apparition 4. North is up and celestial east is to the left. A. Drawing by Carl Roussell, 7 July 2004 1:24 UT, CM = 75. B. Webcam image by Paolo Lazzarotti, 20 July 2004 17:51 UT, CM = 139. C. Webcam image by Steve Massey, 21 July 2004 6:30 UT, CM = 142. D. Drawing by Mario Frassati, 24 July 2004 19:15 UT, CM = 157.

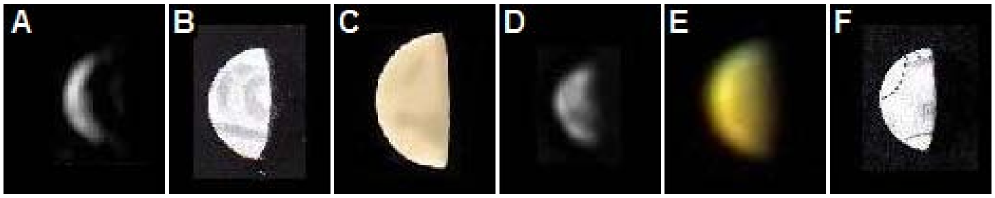

Figure 5: Images from apparition 5. North is up and celestial east is to the left. A. CCD image by Frank Melillo, 6 Sept 2004 13:56 UT, CM = 69. B. Drawing by Carl Roussell, 11 Sept 2004 11:00 UT, CM = 95. C. Drawing by Tom Wilson, 11 Sept 2004 11:30 UT, CM = 95. D. CCD image by Frank Melillo, 12 Sept 2004 14:20 UT, CM = 101. E. Webcam image by Ed Lomeli, 12 Sept 2004 15:02 UT, CM = 101. F. Drawing by Brian Cudnik, 13 Sept 2004 12:15 UT, CM = 105.

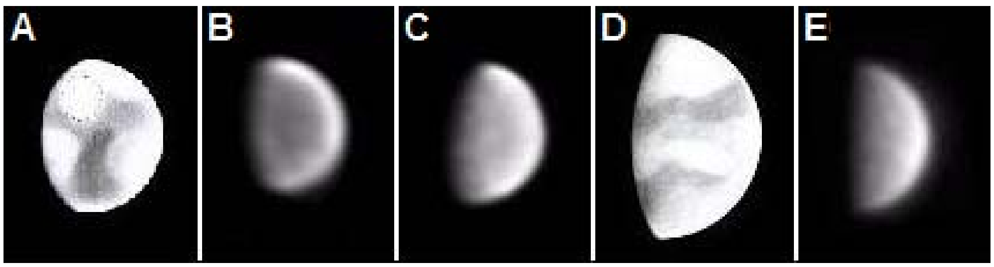

Figure 6: Images from apparition 6. North is up and celestial east is to the left. A. Drawing by Mario Frassati, 13 Nov 2004 12:45 UT, CM = 20°. B. Webcam image by Erwin van der Velden, 14 Nov 2004 7:30 UT, CM = 28°. C. Webcam image by Steve Massey, 15 Nov 2004 6:30 UT, CM = 33°. D. Drawing by Mario Frassati, 20 Nov 2004 16:10 UT, CM = 55°. E. Webcam image by Steve Massey, 25 Nov 2004 16:45 UT, CM = 85°.

issue, there were only five observers who contributed observations. Nevertheless, there were some nearly simultaneous observations.

Cudnik and Melillo started observing Mercury on Sept. 6 (CM=69°). It displayed a crescent with 32% illumination. Melillo's CCD image of that date shows a subtle, dark albedo feature in the southern hemisphere, likely Solitudo Martis and Solitudo Jovis (Figure 5A), but Cudnik's drawing was without albedo features. This exemplifies how difficult these Mercury observations can be!

Mercury reached its greatest elongation 18° west of the Sun as a fat crescent with 45% illumination on Sept. 9 (CM=85°) and Lomeli made a fine webcam image of it (not shown here). Roussell and Cudnik both drew Mercury on Sept 10 (CM=90°). These drawings showed a possible albedo feature in the southern hemisphere. Drawings were made by Roussell and Wilson, and a webcam image by Lomeli, on Sept 11 (CM=95° and 96°). All showed some details in both northern and southern hemispheres. The two drawings are in Figure 5B and 5C.

Then on Sept. 12, Roussell, Wilson, Melillo and Lomeli all observed Mercury at nearly the same time (CM=101°). All four detected the details in the southern hemisphere (Melillo's and Lomeli's images are Figure 5D and 5E). The features are Solitudo Martis and Jovis which were seen to be quite dark during the preceding week. On Sept. 13 (CM=105°), Melillo and Cudnik observed the same albedo details while Mercury reached perihelion (see Figure 5F). These two observers made further observations on Sept. 16 thru 20 (CM=119° thru 137°, respectively) in which they also detected the details in the southern hemisphere.

For the past few years, the region between 70° and 150° longitude has been well observed. Most likely, Solitudo Martis, Jovis and Helii are the darkest albedo features on this side of the disk in the southern hemisphere.

Apparition 6: (Evening) 5 Oct – 10 Dec

This apparition was more favorable for southern hemisphere viewers. Only five observations were reported, by Frassati, Massey and van der Velden.

Frassati was the first to observe, making a fine sketch on Nov. 13 (CM=20°). A large white area in the northern hemisphere is probably Aurora and the dark feature near the equator is Tricrena (Figure 6A). Van der Velden and Massey both imaged Mercury on Nov. 14 and 15 (CM = 28° and 33°, respectively), and they showed possible faint details but these are not clear (Figure 6B and 6C).

Frassati drew Mercury again on Nov. 20 (CM = 55°), showing bands of details which are difficult to match to known albedo features (Figure 6D). The next day, Mercury reached its greatest elongation and finally, Massey imaged it on Nov. 25 (CM = 85°) with a half phase appearance (Figure 6E). Its theoretical phase at that time was about 48.65% illuminated.

Apparition 7: (Morning) 10 Dec – 14 Feb 2005

This was one of the best apparitions of the year and it proved to be the most interesting one. We finally have a clear picture of the part of the surface that was not mapped by the Mariner 10 mission. The northern features at longitude 280° were the central attraction, where one of Mercury's darkest albedo features was well documented. There will be more about this feature in a future issue of the Journal.

After the Dec 10 inferior conjunction, Frassati made very interesting drawings of Mercury starting on Dec 18 (CM = 237°). On that day, he drew two short bands near the terminator, one in the north and one in the south. As he continued to observe Mercury on Dec 20 thru 23 (CM = 250° through 267°), those two bands became more apparent, and the northern one was drawn as the darker of the two (Figure 7A). It is clear that he was drawing Solitudo Aphrodites. (This area has another name, "Skinakas Basin", named for an observatory by an astronomer in Greece).

Melillo captured an apparent Soliudo Aphrodites in an image on Dec 25 (CM = 280°) as a dark region on the terminator north of the equator. Cudnik on Dec 27 (CM = 291°) drew a dark area at the same location (Figure 7B). Again Melillo captured it on Dec. 28 (CM = 296°). His image shows this large dark albedo feature at 280° longitude (Figure 7C).

Mercury reached its greatest elongation 22° west of the Sun on Dec. 29, already showing a gibbous phase at 63% illuminated. In the next two days (Dec 30 and 31, CM = 306° and 311°, respectively), it displayed Solitudo Aphrodites very clearly near the terminator. Wilson's drawing of Dec 31 shows it well (Figure 7D). Melillo and Lomeli imaged Mercury on Jan 1 (2005) (CM = 316°) showing the somewhat dark region at the terminator (Figure 7E). Olivetti also imaged on that day and demonstrated the darkening of the northern part of the terminator (Figure 7F). On Jan 2 (CM = 320° and 323°, respectively) Frassati and van der Velden observed Mercury and it still showed a possible Solitudo Aphrodites on the terminator. Van der Velden's image is Figure 7G.

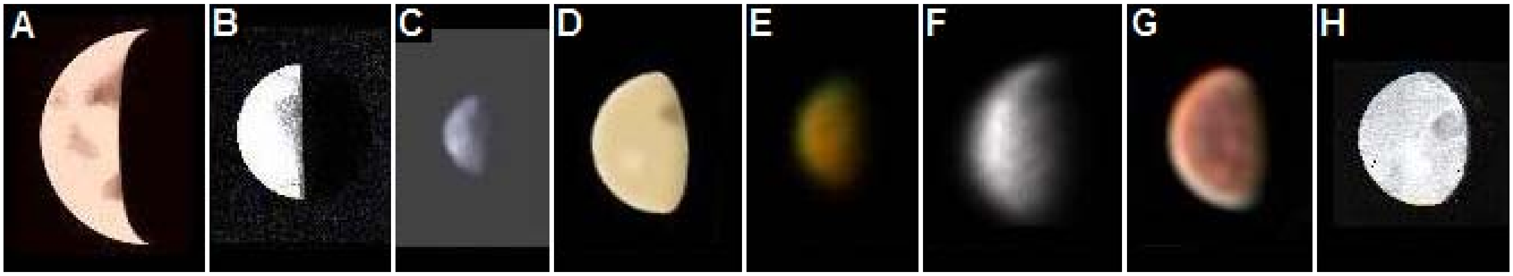

Figure 7: Images from apparition 7. North is up and celestial east is to the left. A. Drawing by Mario Frassati, 21 Dec 2004 6:15 UT, CM = 256°. B. Drawing by Brian Cudnik, 27 Dec 2004 13:00 UT, CM = 291°. C. CCD image by Frank Melillo, 28 Dec 2004 15:05 UT, CM = 296°. D. Drawing by Tim Wilson, 31 Dec 2004 13:30 UT, CM = 312°. E. Webcam image by Ed Lomeli, 1 Jan 2005 18:52 UT, CM = 316°. F. Webcam image by Tizano Olivetti, 1 Jan 2005 23:15 UT, CM = 318°. G. Webcam image by Erwin van der Velden, 2 Jan 2005 20:15 UT, CM = 323°. H. Drawing by Carl Roussell, 13 Jan 2005 12:25 UT, CM = 014°.

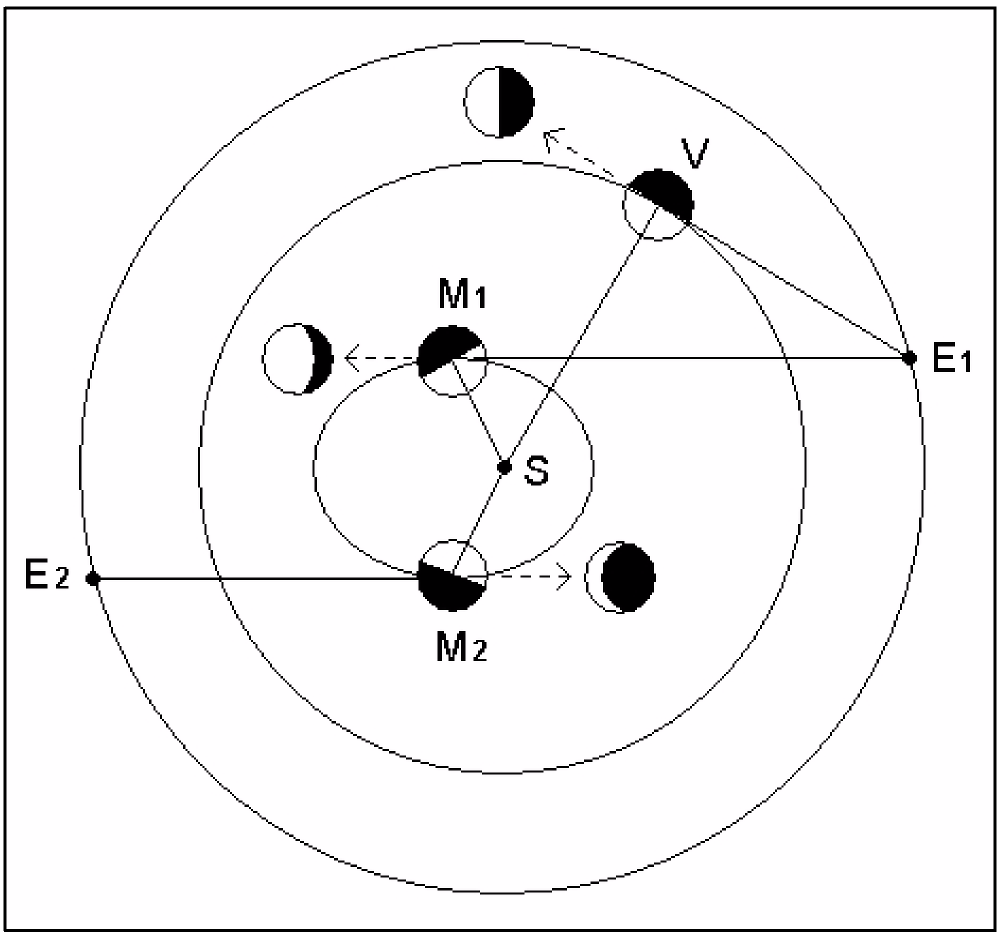

Figure 8: The phase of Mercury at greatest elongation. In the diagram, S is the Sun, V is Venus, E1 and E2 are two positions of Earth, and M1 and M2 are two positions of Mercury corresponding to E1 and E2. Greatest elongation occurs when the line of sight from Earth to the inner planet is tangent to the orbit of the inner planet. These greatest-elongation lines of sight are drawn in the diagram (E1 to V, E1 to M1, and E2 to M2.) The orbits of Earth and Venus are nearly round. Consequently, when Venus is at greatest elongation from the Sun, the S - V - E angle is always 90°, and Venus is seen from the Earth (E1) to be at half phase. In contrast, the elliptical orbit of Mercury causes its appearance at greatest elongation to vary greatly, because the S - M - E angle varies greatly. S - M1 - E1 is less than 90°, so that Mercury is seen as gibbous, while S - M2 - E2 is greater than 90° so that Mercury is seen as a crescent. The phase of Mercury at elongation can be anywhere from about 35% to 65% illuminated.

As the gibbous phase grew fuller, Frassati and Roussell continued to draw Mercury on Jan 3 thru 15 (CM = 325° thru 023°, respectively), repeatedly indicating a dark region where Solitudo Aphrodites is located. Cudnik made the last drawing on Jan 17 (CM = 33°) showing nearly a blank disk. Mercury ended the show at superior conjunction on Feb 14, 2005.

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Feature Story:

On the Reliability of the Lunar Drawings Made by Hugh P. Wilkins

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Introduction

In Charles A. Wood's book *The Modern Moon. A personal view*, Hugh P. Wilkins is described as "a poor scientist and an even worse cartographer" [Wood, 2003, p. xix]. That statement may appear blasphemous to some aged amateurs, like me, who grew up in the Sixties under the influence of the British school of lunar observers who were active in the 19th and 20th centuries, right up to the Apollo Era. Whenever I noticed any disagreement between my drawings and their drawings of the same lunar feature, I assumed that my predecessors were correct, attributing my "errors" to poor seeing, misaligned optics or general inability in observing and drawing.

However, with the advent of CCD imaging, in the 1990s, it became evident to me that the lunar drawings made by Wilkins, which appeared in his books and articles, lack the accuracy needed to be taken as standards for comparison with other observations.

In this paper I wish to comment on a few but significant cases which will demonstrate the low reliability of the Wilkins drawings.

Procedure

In this study I have compared the following types of sources for four selected features:

- Lunar drawings, single or pairs, made by Wilkins and which appeared in his books *The Moon* [Wilkins and Moore, 1961] and *Our Moon* [Wilkins, 1954];
- CCD images of the same features taken with a "Cookbook camera" (TC 245 sensor) through my 30.5-cm, f/6.5 Newtonian telescope fitted with a TeleVue 3X Barlow, obtaining an equivalent focal ratio of about f/20;
- Images of the same subjects recorded by NASA Lunar Orbiter 4 [Gillis, 1999].

All the images presented here are reproduced in the standard telescopic orientation; south is up and lunar east is to the left. For each image whose accurate time was known, the Sun's colongitude, C, height, H, and azimuth, A, were calculated with the *Lunar Observer's Tool Kit* software by Harry Jamieson and are given in the caption of the figure.

Discussion

In order to demonstrate the high reliability of CCD images, even those taken by an unskilled astroimager like me, I have compared some of my images with those obtained by Lunar Orbiter 4 of the same lunar features. Figure 1 shows Petavius recorded at my observatory, while Figure 2 is an image of the same complex crater taken by Lunar Orbiter 4. Apart from the different perspective, which I approximately corrected by deforming the Lunar Orbiter picture, and slightly different lighting conditions, the two images display the same large-scale features, while – as expected – the NASA image shows many minute details which are well beyond the power of my instrument. As far as the smallest features recorded in my image

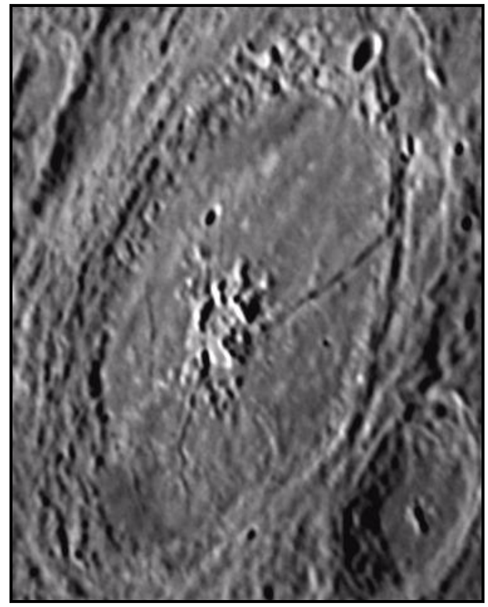

Figure 1. Petavius imaged by the author on 14 April 2005, 19h 10m UT. C = 337°.9, H = 34°.7, A = 072°.6.

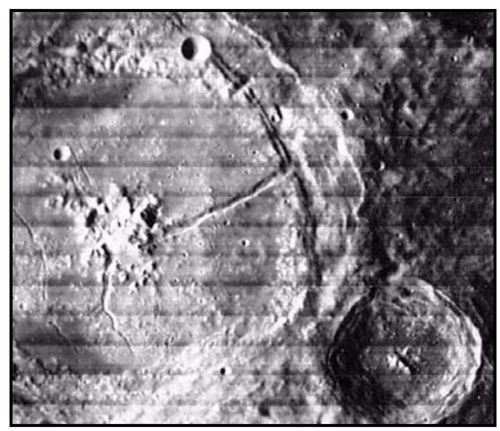

Figure 2. Petavius imaged by Lunar Orbiter 4 (IV-053-H1) on 14 May 1967, 05h 02m 29s UT. C = 329°.3, H = 26°.4, A = 075°.9.

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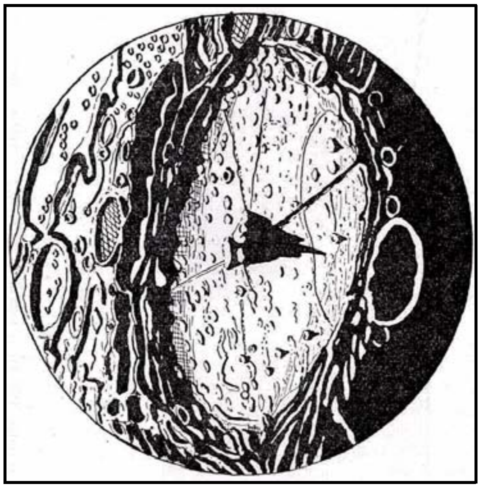

Figure 3. Petavius drawn by Wilkins while observing the Moon at Meudon, published in *Our Moon* [Wilkins, 1954]. No data available.

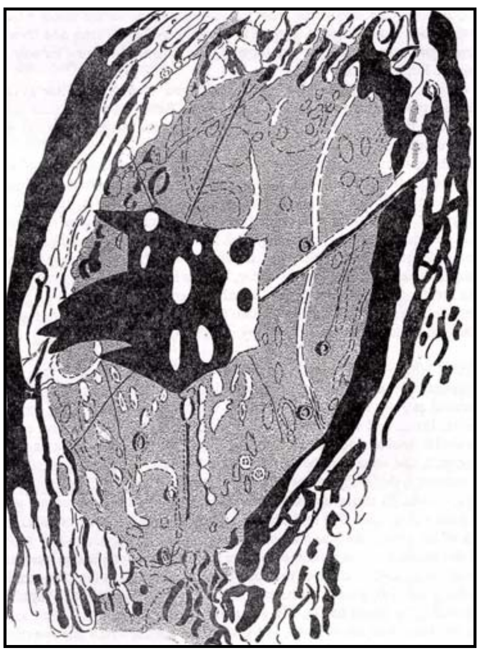

Figure 4. Petavius portrayed by Wilkins while observing the Moon with the 30-in reflector at Cambridge (5 October 1952), published in *The Moon* [Wilkins and Moore, 1961]. C = 115°.1, H = 4°.7, A = 270°.6.

are concerned, they are easily recognizable in the Orbiter photograph, confirming the impersonality of CCD's. We may consider for example:

- the details of the central peaks;
- the shapes and directions of the clefts on the crater floor;
- the shape and position of even the smallest craters recorded in my image on the floor and on the walls of Petavius.

One peculiarity of my image deserves mention. The smallest craters have lost their expected elliptical shape (due to foreshortening) and have become more circular. I have often observed this effect in CCD images of lunar craterlets (e.g., those on the Plato's floor), but I have never read a convincing explanation for the effect. Fattinnanzi [private communication, 2005] has suggested to me that the origin of such a circularization may be the unsharp masking algorithm, which produces a circular symmetric effect around features a few pixels wide.

We now compare with each other, and with figures 1 and 2, two drawings of Petavius made by Wilkins. The first (Figure 3, [Wilkins, 1954, p. 40]) was recorded while observing through the 83-cm refractor of Meudon Observatory (France), the second (Figure 4, [Wilkins and Moore, 1961, p.174]) while using the 75-cm reflector of Dr. W. H. Steavenson at Cambridge (England). Figures 3 and 4 appear to display two different lunar craters, so many and significant are the differences between them, even taking into account their considerably different lighting conditions. Comparing these drawings with the images of figures 1 and 2, the following impressions can be drawn.

First, the central peaks appearing in the two drawings differ significantly in complexity and size relative to the size of the crater floor.

Second, the largest crater on the floor of Petavius is shown in the two drawings in two different neighborhoods. Wilkins' habit was to use a continuous line to depict a cleft, plus a parallel dashed or interrupted line for the largest clefts. He used two parallel dashed lines to show a ridge. Thus, in Figure 3, the crater appears to the east of a prominent cleft running from the central peak toward the 11 o'clock position. This corresponds well to the position of the crater in figures 1 and 2. However, in Figure 4 it lies to the west of the same cleft, and to the east of a ridge that is not present in Figure 3. This ridge is not identifiable in either Figure 1 or Figure 2. Another cleft that runs from the central peaks roughly toward 12 o'clock is seen in both of Wilkins' drawings. Neither Figure 1 nor Figure 2 shows this cleft, only a line of hills at best.

Third, both of Wilkins' drawings report another cleft on the eastern part of the Petavius floor that appears nearly to be the northeast extension of the major cleft that dominates the south-western part of the floor. This subtle cleft is undetectable in Figure 2, while Figure 1 can offer a hint of comprehension: maybe Wilkins interpreted as a cleft the border between the dark surface of the floor and a row of high-albedo hills.

Fourth, figures 1 and 2 show that the eastern part of the crater floor contains a distinct cleft running roughly north-south. Though it might be hidden in the shadow of the central peaks in Figure 4, its complete absence from Figure 3 is remarkable.

These four facts outline the lack of consistency between different Wilkins' drawings of the same subject, and suggest a high subjectivity and a weak perspicacity of Wilkins as an observer.

Moreover, notice in Figure 4 the conspicuous curvature of some shadows of the central peaks. While a convex shadow profile can be clearly accounted for by a convex profile (slope decreasing with height) of the mountain casting the shadow, a concave shadow implies a concave profile of the mountain, which is highly improbable in the smooth lunar landscape. This form of shadow, which is similar to another well known curved shadow (on Plato's floor, see below), could be explained by the presence of some unusual relief on the crater's floor or by inaccurate depiction.

A preliminary conclusion about the observing style of Wilkins appears from the comparisons made so far, and will be confirmed later. It is likely that Wilkins didn't trace even a rough outline of the subject prior to making the drawing, but he probably recorded *ex novo* all the features at the telescope, without being influenced by previous observations of the same feature.

Figures 5 and 6 show Gassendi as imaged by the author and by Lunar Orbiter 4, respectively (the latter has been deformed

Figure 5. Gassendi imaged by the author on 23 April 2002, 22h 00m UT. C = 048°.1, H = 8°.1, A = 088°.6.

Figure 6. Gassendi imaged by Lunar Orbiter 4 (IV-143-H2) on 21 May 1967, 17h 28m 22s UT. C = 061°.0, H =19°.9, A = 082°.7.

to approximate the earth-based view). Comparison between these images confirms the impersonality of CCD cameras in recording lunar features. Even if recorded under slightly different illuminations, the smallest features appearing in Figure 5 are perfectly recognizable in the much more detailed Figure 6.

We now turn to the peculiar technique adopted by Wilkins, comparing with figures 5 and 6 and between them, two drawings of Gassendi by Wilkins, one appearing in *The Moon* (Figure 7, [Wilkins and Moore, 1961, p. 146]) and the other taken from *Our Moon* (Figure 8, [Wilkins, 1954, p. 81]), both reporting the floor-fractured crater as observed on 24 April 1953 through the 83-cm of Meudon. At least six clefts run nearly east-west on the floor of Gassendi according to the Wilkins drawing in Figure 7, but there is no clear confirmation of them in figures 5 and 6, where only the southernmost of these clefts appears.

Moreover, in the impersonal images, this cleft shows an irregular course, while Wilkins depicts it as a straight feature. Most of the clefts running nearly north-south in the Wilkins drawing have no exact counterpart in figures 5 and 6, where the regular parallel pattern dominating Figure 7 is completely absent. Another feature misinterpreted in the Wilkins drawing is the large crater he depicts on the west rim of Gassendi. Figures 5 and 6 clearly show that this formation is not a crater, but a large, triangular landslide.

A little additional insight into Wilkins' peculiar modus operandi is gained by considering Figure 8, which shows the same crater Gassendi, observed at Meudon on 24 April 1954, as it appears in *Our Moon*. At a first glance, this image appears indistinguishable from that of Figure 7, as it should be expected because both drawings concern the same observing session. However, more careful inspection reveals minor but significant differences between the two. One example is the central peaks, another is the mountain chain surrounded by shadow west of Gassendi. One logical but surprising explanation for the differences between figures 7 and 8 may be that Wilkins redrew by hand different copies of the same illustration for the different books he authored, perhaps to avoid copyright problems.

One of the most intriguing features recorded by Wilkins on his drawings is the well known "hooked shadow" reported on Plato's floor on 3 April 1952, when he and Patrick Moore observed the Moon through the 83-cm Meudon refractor.

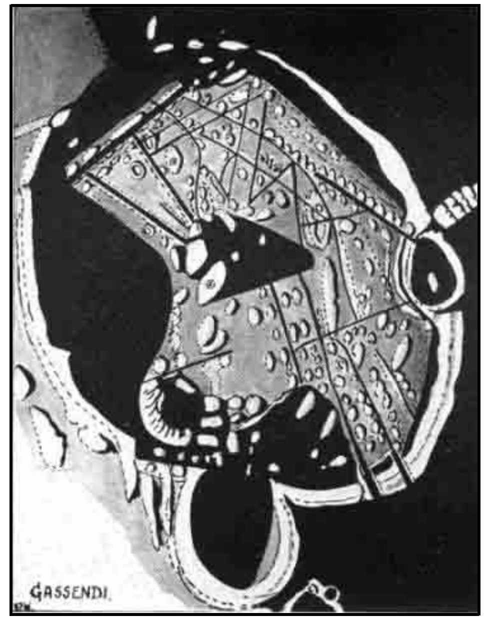

Figure 7. Drawing of Gassendi made by Wilkins on 24 April 1953 with the Meudon refractor. C = 041°, H = 1°, A = 088° (approximately). The Sun is lower than in figures 5 and 6, so the perception of the small features should have been better in this drawing. F*rom The Moon* [Wilkins and Moore, 1961].

Figure 8. Gassendi observed on 24 April 1953 at Meudon, as it appears in *Our Moon* [Wilkins, 1954].

Comparing the next three "hooked shadow" drawings with each other provides additional information about Wilkins' observing and drawing style. The first drawing (Figure 9) is taken from *The Moon* [Wilkins and Moore, 1961, p. 234], and is clearly by Wilkins, according to the original caption appearing at the bottom of the figure. In the book *Our Moon*, [Wilkins, 1954, p. 70], there is a quite different drawing, shown here as Figure 10,

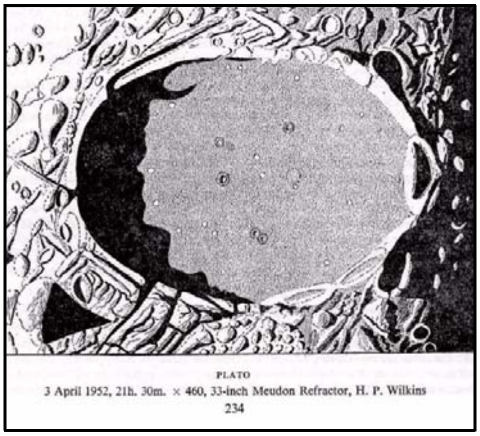

Figure 9. The hooked shadow on Plato's floor. (C = 16.5°; H = 5,3°; A = 94.9°).

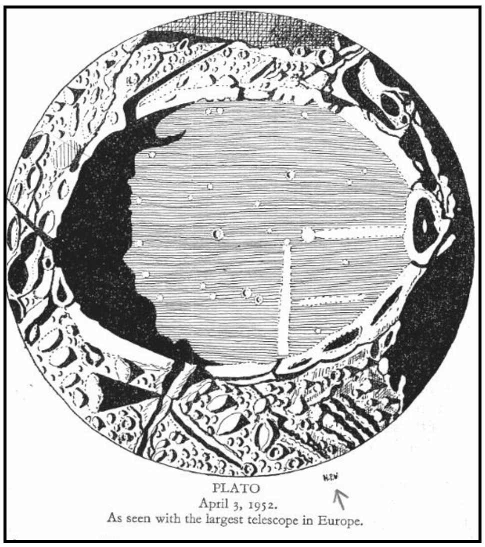

Figure 10. Another drawing of the hooked shadow. (A minor mistake is made in the original caption that is included in the figure: the Meudon 83-cm refractor was NOT Europe's largest telescope at that time; that title belonged to the 122-cm reflector of Padova-Asiago Observatory in Italy. The Meudon 83-cm was and remains the largest *refractor* in Europe.)

whose caption explains that it represents Plato as it appeared during the same observing session at Meudon on 3 April 1952. A translation of *Our Moon* into the Italian language, under the title *Guida alla Luna*, appeared in 1959 and contained the drawing reported here in Figure 11 (shown here including its original caption labelling it as Figure 12) [Wilkins, 1959, p. 72]. At first look, Figure 11 is identical to Figure 10, but very careful inspection reveals subtle differences that show that one is an inexact copy of the other. Given the profound differences existing between the drawing appearing here as Figure 9 and the one shown in Figure 11, an article published in Italy attributed the drawing of Figure 11 to Patrick Moore, who was observing with Wilkins at Meudon that night [Ferreri, 1993]. I published in *The Strolling Astronomer* two papers concerning the "hooked shadow" on Plato's floor that contained this error [Favero, et al, 2000; Favero, et al, 2001]. After the publication of these papers, the proof that the drawing in Figure 11 was made by Wilkins was provided to me by John Westfall, who kindly sent me the image appearing here as Figure 10. On it an arrow traced by John Westfall indicates the initials of the draftsman: HPW, i.e., Hugh Percy Wilkins!

Even more singularly than the Petavius case (Figures 3 and 4), the two drawings of Plato in Figures 9 and 10 show so many differences as to make it astonishing that they were made by a single observer during a single telescopic session. (Compare them with the Orbiter 4 photo of Figure 12 to verify the significant imprecision in both Wilkins' drawings.) How could this have happened? A possible explanation is that Wilkins never produced a complete and accurate drawing of the feature at the telescope, only shorthand notes or incomplete sketches. Later, when Wilkins redrew *ex novo* any drawing needed for each edition of his books, he did so without any reference to a definite and complete original. This is the reason, together with the possible necessity to overcome copyright problems, which led Wilkins to produce drawings of the same feature on the same night that were evidently different.

Among the many features* observed by Wilkins on 3 April 1952 at Meudon there is "Gueriké" (Guericke in the IAU nomenclature, which was often modified or added to by Wilkins). His drawing is reproduced in *The Moon* [Wilkins and Moore, 1961, p. 127] and is shown here as Figure 13. The Sun was still low over Guericke at that time, at elevation 2°.4, and the shadow completely filled craters "A" and "7". Wilkins' "A" is conventionally mapped as Guericke D, his "2" appears to be Guericke H and his "7" appears to be the crater pair Guericke J and S.

No Lunar Orbiter image documented the same lighting conditions for this formation, but compare Figures 13 and 14 to verify the inaccuracies on Wilkins' drawing (e.g., the crater pits 9 to 12 and the row η^4).

My image in Figure 15 can be of help: here the shadow does not completely fill crater "A", because the lunar age in the image is later than in the Wilkins scene (H = 7°.1 against 2°.4). In Figure 15, the peak "δ" (identified as such at the bottom of Wilkins drawing) casts a prominent shadow which spans half the distance between peaks "δ" and "ε" (compare Figures 13 and 15; "δ" and "ε" are Wilkins' own designations). That shadow should have been well more extended at the time of the Wilkins observation, but is simply absent from his drawing.

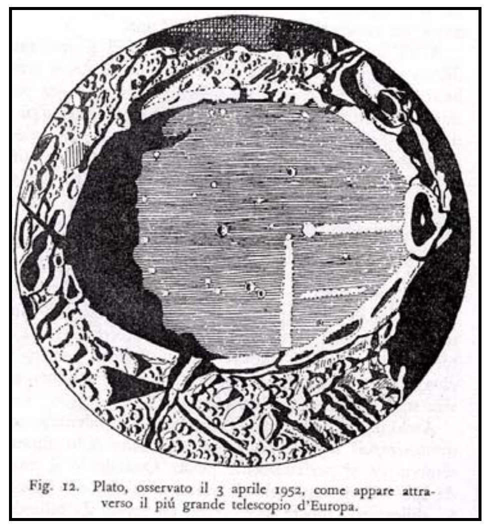

Figure 11. The version of Wilkins' Plato drawing that appeared in the Italian edition of *Our Moon*.

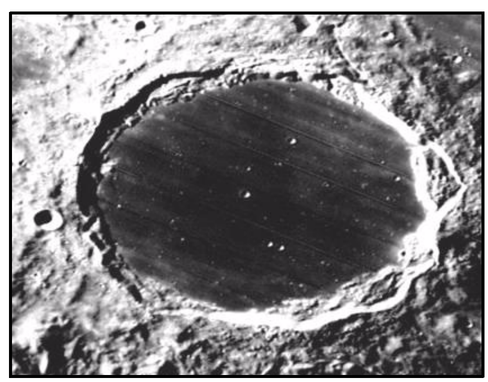

Figure 12. Plato imaged by Lunar Orbiter 4 (IV-143-H2) on 21 May 1967, 17h 28m 22s UT. C = 061°.0, H =19°.9, A = 082°.7.

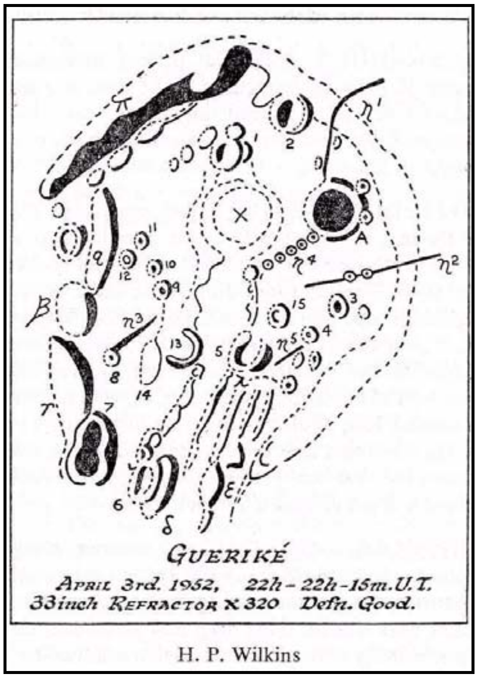

Figure 13. Gueriké (IAU Guericke) drawn by Wilkins on 3 April 195, 22h - 22h 15m UT. C = 016°.7, H = 2°.4, A = 088°.4.

Here we learn of another Wilkins peculiarity: sometimes he doesn't draw the shadows, not consistently but occasionally! To account for the different appearance of the shadows in different regions of the drawing, a possible explanation is that Wilkins separately recorded some features under a very low Sun on the April 3 session, and then added some other details as observed in a subsequent session under a higher Sun. Yet, this would not explain the lack of the prominent crater pit between his peaks "δ" and "ε" that is clearly seen in the Lunar Orbiter image of Figure 13. It is similar in dimension to the craters he numbered 3, 8 and 9, and it should be clearly visible under a high Sun.

Conclusions

I think that I have provided the reader with sufficient proofs of the Wilkins oddities. I think that he never drew a complete figure at the telescope, but simply recorded "shorthand notes", or at most very rough and partial sketches. This is particularly true for the night of 3 April 1952 at Meudon when, according to *The Moon*, he must have portrayed at least nine features and allowed Moore to do nearly the same — an impossible feat if all were drawn at the eyepiece*! Only later did he draw his figures based on his notes and perhaps on his memory. In three books, *The Moon, Our Moon*, and the latter's Italian translation, *Guida alla Luna*, all showing Plato as observed on 3 April 1952 at Meudon, Wilkins chose – perhaps to overcome copyright problems – to redraw the same subject three times. In the absence of a single, reliable original, these drawings were perforce different.

In consideration of the uncertainties caused by his peculiar observing and drawing methods, the observations collected by Wilkins, even when using the largest telescopes of the professional observatories of his time, cannot reliably be used for comparison with observations made by others. So, I think that we need worry no more about the "hooked shadow" or similar oddities we inherited from Wilkins' observations: they are simply not documented beyond any reasonable doubt and fail to appear in modern electronic images, even those taken by less-skilled astroimagers such as myself.

* The features are (in parentheses the page in *The Moon* where the relevant observation is discussed): Archimedes (92); Canon (94); Copernicus (111); Stadius (118); Guericke (127); Alpetragius (138); Birt (140); Cassini A (228); Plato (234).

Figure 14. Gassendi imaged by Lunar Orbiter 4 (IV-143-H2) on 21 May 1967, 17h 28m 22s UT. C = 061°.0, H =19°.9, A = 082°.7.

Figure 15. Guericke imaged by the author on 21 April 2002, 17h 00m UT. C = 021°.2, H = 7°.1, A = 089°.7.

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Feature Story:

Observations During the 1999 - 2000 and 2000 - 2001 Apparitions of Jupiter

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Abstract

Drift rates for over a dozen Jovian currents are reported for the 1999-2000 and 2000-2001 Apparitions. Ovals BE and FA merged in early 2000 creating oval BA. The writer believes that this merger was hastened when ovals BE and FA passed the GRS in late 1999. The selected normalized magnitudes for Jupiter in late 2000 are: B(1,0) = -8.51 ±0.04, V(1,0) = -9.38 ±0.01, R(1,0) = -9.86 ±0.002 and I(1,0) = -9.77 ±0.02, while the corresponding values for the solar phase angle coefficients (in magnitudes/degree) are: c_B = 0.011 ±0.007 , c_V = 0.005 ±0.001 , c_R = 0.006 ±0.003 and c_I = 0.005 ±0.003.

Introduction

Several important Jupiter studies and developments took place between 1999 and 2001. The Cassini probe, for example, made a close approach to Jupiter in late 2000. The two large South Temperate Belt (STB) ovals BE and FA merged in March 2000 (Sanchez-Lavega *et al.*, 2001) to form Oval BA; this occurred about two years after BC and DE merged to form BE. Simon Miller and co-workers (2000) used Voyager infrared data to look for water ice on Jupiter; after a thorough analysis, they reported that some of the data are consistent with the presence of water ice clouds on Jupiter.

Amateur astronomers also carried out important Jupiter work between 1999 and 2001. Rogers (2003) and Rogers and co-workers (2000, 2003, 2004a,b, 2005) summarized the 1999-2000 and 2000-2001 Jupiter apparitions in both visible and infrared light. Schmude and Lesser (2000) reported photoelectric magnitude measurements of Jupiter made during 1999-2000. This report summarizes observations of Jupiter made mostly by ALPO and ALPO of Japan members between 1999 and 2001.

Table 1 lists the characteristics of the 1999-2000 and 2000-2001 Jupiter apparitions and Table 2 lists the people who contributed (or made available) Jupiter observations during these apparitions. Figure 1 shows the nomenclature of Jupiter along with drawings of that planet made in 1999-2001. Images of Jupiter made in 1999-2001 are shown in figures 2 and 3, while longitudes of Jovian features are shown in Figure 4 (1999-2000 Apparition) and Figure 5 (2000-2001 Apparition). In figures 1 thru 3, south is at the top and the preceding limb is at the left.

Table 1: Characteristics of the 1999-2000 and 2000-2001 Apparitions of Jupiter[a]

Apparition Period (conjunction to conjunction)	Apr. 1, 1999 - May 8, 2000	May 8, 2000 – June 14, 2001
Opposition date	Oct. 23, 1999	Nov. 28, 2000
Apparent equatorial diameter (opposition)	49.7 arc-sec.	48.7 arc-sec.
Visual stellar magnitude (opposition)	-2.9	-2.9
Planetographic declination of the Sun (opposition)	3°.4N	3°.4N
Planetographic declination of the Earth (opposition)	3°.8 N	3°.6N
Geocentric declination of Jupiter (opposition)	10°.0N	20°.4N

[a]Data taken from The Astronomical Almanac (1998, 1999)

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Observing Scales

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

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

Scale of Transparency Conditions:
- Magnitude of the faintest star observable when allowing for daylight and twilight

IAU directions are used in all instances.

This paper will follow certain conventions. The planetographic latitude is used in this paper. West refers to the direction of increasing longitude. Longitude is designated with the Greek letter λ (lambda), followed by a Roman numeral subscript, which designates the longitude system. As an example, λ_I = 054° means that the System I longitude equals 54°. The three longitude systems are described in (Rog-

Table 2: Those Who Submitted Jupiter Observations During the 1999-2000 and 2000-2001 Apparitions

Name and Location	Telescope[a]	Type[b]	Name and Location	Telescope[a]	Type[b]
Adachi, Makoto; Japan	0.40-m C	D, DN	Keene, Stephen; OH USA	0.33-m RL	DN
Akutsu, Tomio; Japan	0.32-m RL	I	Lazzarotti, Paolo; Italy	0.18-m MC	I
Amato, Michael; CT USA	0.15-m RL	D	Leong, Tan Wei; Singapore	0.28-m SC & 0.25-m RL	I
Astin, Tim; GA USA	0.25-m RL	D	MacDougal, Craig; FL USA	0.15-m RL	D, DN, TT
Auriemma, Joe; GA USA	0.25-m RL	D	Maeda, Kazuyoshi; Japan	0.35-m RL	I
Berg, Ray; IN USA	0.20-m SC	D, DN	Massey, Steve; Australia	0.61-m C	I
Boyar, Dan; FL USA	0.15-m RR & 0.20-m RL	D, DN	McAnally, John; TX USA	0.20-m SC	DN
Carlino, Lawrence; NY USA	0.15-m RR	D	Melillo, Frank; NY USA	0.20-m SC	DN, I
Cassini Mission Scientists	---	I	Mettig, Hans-Joerg; Germany	---	DN
Chu, Alan; China	0.25-m RL	I	Miyazaki, Isao; Japan	0.40-m RL	I
Cidadao, Antonio; Portugal	0.25-m SC & 0.28-m SC	I	Montagano, Dan	0.20-m MC	D
Colville, Brian; ON Canada	0.30-m SC	I	Nakanishi, Hidekazu; Japan	0.25-m SC	I
Crandall, Ed; NC USA	0.25-m RL	D, DN, TT, SS	Ng, Eric; China	0.25-m RL	I
Cudnik, Brian; AZ USA	Several	D, DN, TT	Niikawa, Masahito; Japan	0.28-m SC	I
Del Valle, Daniel; PR USA	0.20-m RL	D, DN, TT	Nikolai, Andre; Germany	0.10-m RR	D
Di Sciullo, Maurizio; FL USA	---	I	Nishitani, Teruaki; Japan	0.21-m RL	I
Dobbins, Tom; OH USA	---	DN	Okuda, Koji; Japan	0.25-m RL	I
Einaga, Hideo; Japan	0.25-m RL	I	Orton, Glen; CA USA	Galileo Probe & IRTF	DN, I
Faworski, Sheldon; FL USA	---	I	Oshihoi, Yukio; Japan	0.21-m RL & 0.25-m RR	I
Ferreira, Jim; CA USA	0.15-m M	I	Parker, Don; FL USA	0.41-m RL	I
Frassati, Mario; Italy	0.20-m SC	D, DN, TT	Parker, Tim; CA USA	0.20-m RL & 0.31-m C	I
Gossett, Rick; MI USA	0.20-m SC	D	Peach, Damian; UK	0.28-m SC & 0.31-m SC	I
Grafton, Ed; TX USA	0.36-m SC	I	Pellier, Christophe; France	0.18-m RL	I
Gross, Todd; USA	---	DN, I	Pic du Midi Observatory; France	---	I
Haas, Walter; NM USA	0.32-m RL	D, DN, TT	Pither, Colin; UK	---	TT
Hancock, Carlos; FL USA	0.20-m SC	D	Post, Cecil; NM USA	0.20-m RL & 0.31-m RL	TT
Harris, Tim; WA USA	0.18-m M	D, TT	Pulley, Harry; ON Canada	0.15-m RL	D, DN, TT
Hernandez, Carlos; FL USA	0.20-m SC	D, SS	Rogers, John; UK	---	DN
Higgins, Larry; GA USA	0.25-m RL	D, DN	Sabia, John; PA USA	0.24-m RR	D, DN, TT
Horikawa, Kuniaki; Japan	0.16-m RL	D	Sanchez-LaVega, Agustin; Spain	---	DN
Huckeba, Ken	---	DN	Schmude, Richard Jr.; GA USA	0.10-m RR & 0.09-m M	D, DN, TT, PP
Iga, Yuichi; Japan	0.28-m SC	I	Stuart, Danielle; GA USA	0.25-m RL	D
Ikemura, Toshihiko; Japan	0.31-m RL	I	Stuart, Mike; GA USA	0.25-m RL	D
Ito, Noriyuki; Japan	0.60-m C	I	Tomney, Jim; MD USA	0.25-m RL	DN, I
Jamison, Eric	0.18-m RR	DN, TT	Whitby, Sam; VA USA	0.15-m RL	D, DN, SS, TT
Karasawa, Hideyuki; Japan	0.30-m RL	I	Yoneyama, S; Japan	0.20-m RL	I
Kawahara, Yoshinori; Japan	0.25-m C	I			

[a] C = Cassegrain, M = Maksutov, MC = Maksutov-Cassegrain, MN = Maksutov-Newtonian, RL = Reflector, RR = Refractor, SC = Schmidt-Cassegrain
[b] D = drawing, DN = Descriptive notes, I = CCD or video image, PP = Photoelectric Photometry, SS = Strip Sketch, TT = Central-Meridian Transit time

ers, 1995, 11) and Astronomical Almanac, 1999, L10). All dates and times are in Universal Time (UT). Currents are abbreviated; for example, the STrC is the South Tropical Current and the NNTC-B is the North North Temperate Current – B. Unless stated otherwise, all data are based on visible-light images. All drift rates outside of the EZ, NEBs, SEBn and the NTC-C are based on System II longitudes; otherwise they are based on System I longitudes.

Disc Appearance

Several people estimated the brightness (or light intensity) of Jupiter's features; all estimates were made on (or converted to) the Standard ALPO scale of 0 = black to 10 = white. The mean light intensities for 1999-2000 and 2000-2001 are shown in Table 3. One significant change between 1999-2000 and 2000-2001 was the NTB, which became lighter. The NTB was reported to be light at some longitudes and dark at others in late 2000. According to images made between Aug. 19 and Aug. 21, 2000, the NTB was dark at 014° $< \lambda_{II} <$ 258° and light elsewhere; the NTB is relatively faint in Figure 3D. The EZ is much brighter in Figure 3 than in Figure 2, which is consistent with the intensity estimates.

The writer measured the latitudes of belts on Jupiter at six different System II longitudes and then computed mean latitudes for each belt/zone boundary; the results are listed in Table 4. The latitudes were computed in the same way as in Peek (1981, 49); the necessary planetographic latitudes were taken from The Astronomical Almanac (1998, 1999). The biggest change was the southward shift of both the SEBn and NNTBs in late 2000. The change in the SEBn may be due to the development of a string of white ovals at the SEBn in 2000-2001; see figure 3B and 3F.

The writer used the same method as in Schmude (2002a, 26) to measure the dimensions of Jupiter's white ovals; tables 5 and 6 show the results in 1999-2000 and 2000-2001. The mean area of the SSTB ovals was 15 x 10^6 km^2 in 1999-2000 and 18 x 10^6 km^2 in 2000-2001; these values are a bit lower than the mean

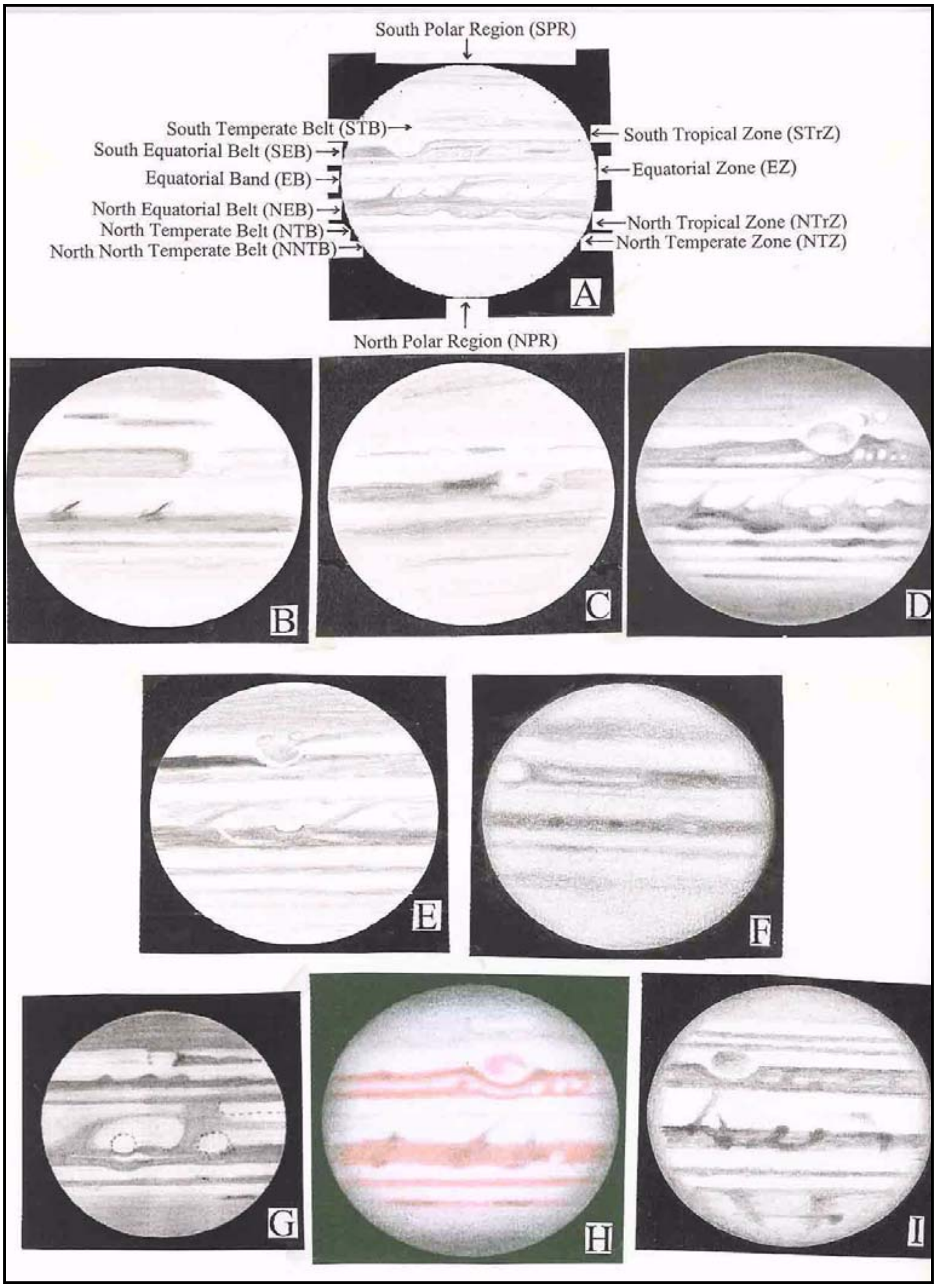

Figure 1: Drawings of Jupiter made during the 1999-2001 Apparitions. A: Sep. 8, 1999 (10:06 UT) by Brian Cudnik, 0.25-m RL (λ_I = 321°, λ_{II} = 096°); B: July 27, 1999 (08:22 UT) by Daniel del Valle, 0.20-m RL (λ_I = 306°, λ_{II} = 049°); C: Aug. 3, 1999 (09:10 UT) by Ed Crandall, 0.25-m RL (λ_I = 001°, λ_{II} = 050°); D: Oct. 6, 1999 (22:10 UT) by Mario Frassati, 0.20-m SC (λ_I = 147°, λ_{II} = 064°); E: Nov. 23, 1999 (02:08 UT) by Craig MacDougal, 0.15-m RL (λ_I = 159°, λ_{II} = 076°); F: Feb. 25, 2000 (01:24 UT) by Richard Schmude, Jr., 0.10-m RR (λ_I = 203°, λ_{II} = 123°); G: Aug. 2, 2000 (03:55 UT) by Damian Peach, 0.31-m SC (λ_I = 167°, λ_{II} = 313°); H: Jan. 26, 2001 (17:40 UT) by Mario Frassati, 0.20-m SC (λ_I = 187°, λ_{II} = 059°); I: Feb. 13, 2001 (23:35 UT) by Lawrence Carlino, 0.15-m RR (λ_I = 004°, λ_{II}= 096°). RL = reflector, RR = refractor, SC = Schmidt-Cassegrain.

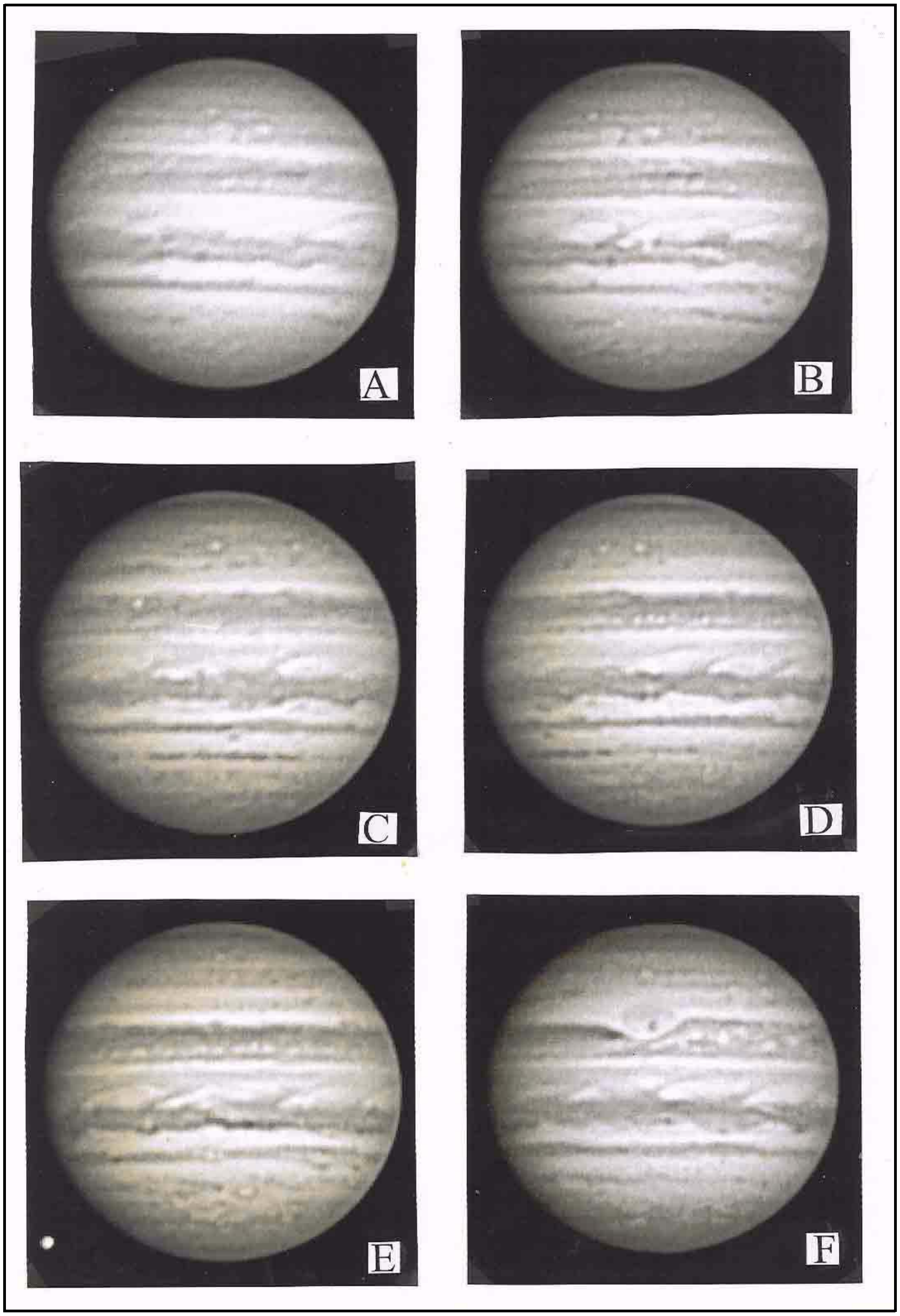

Figure 2: Images of Jupiter made by Isao Miyazaki during the 1999-2000 Apparition; all images were taken through a 0.41-m RL in integrated light. A: June 26, 1999, 19:56 UT (λ_I = 156°, λ_{II} = 132°); B: July 8, 1999, 20:07 UT (λ_I = 257°, λ_{II} = 141°); C: July 30, 1999, 19:45 UT (λ_I = 116°, λ_{II} = 193°); D: Aug. 4, 1999, 20:17 UT (λ_I = 205°, λ_{II} = 243°); E: Aug. 14, 1999, 20:00 UT (λ_I = 334°, λ_{II} = 296°; satellite Ganymede to lower left); F: Aug. 29, 1999, 21:10 UT (λ_I = 226°, λ_{II} = 073°).

Table 3: Mean Intensities of Features on Jupiter During the 1999-2000 and 2000-2001 Apparitions
(All intensities on the Standard ALPO Scale of 0 = darkest to 10 = brightest)

Feature	1999-2000 Intensity	2000-2001 Intensity
SPR	6.2	6.0
SSTZ	---	7.5
SSTB	5.5	6.2
STZ	7.0	6.8
STB	6.1	6.1
STrZ	8.0	7.5
SEB	4.3	4.9
EZ	7.1	8.1
EB	7.0	7.1
NEB	3.5	4.0
NTrZ	7.9	7.8
NTB	5.0	5.9
NTZ	7.9	7.6
NNTB	5.7	6.0
NNTZ	---	6.8
NPR	6.1	5.9
GRS	7.3	7.4

area for 1986-1996, 21 x 10^6 km^2 (Schmude and McAnally, 2005).

Region I: Great Red Spot

Boyar and del Valle reported a pinkish color for the GRS on Nov. 18 and Dec. 10, 1999 respectively, while Frassati reported a pink-salmon color for this feature on Sep. 26 and Oct. 6, 1999. Frassati reported an orange-salmon color for the GRS on Jan. 26 and Feb. 26, 2001.

The GRS was at λ_{II} = 068°.3 ± 1°.2 and 074°.6 ± 0°.5 at opposition in 1999 and 2000 respectively. The drift rate of the GRS remained nearly constant in 1999-2000 and 2000-2001. The drift rates for the features described here and below are summarized in tables 7 through 13 and graphed on figures 4 and 5.

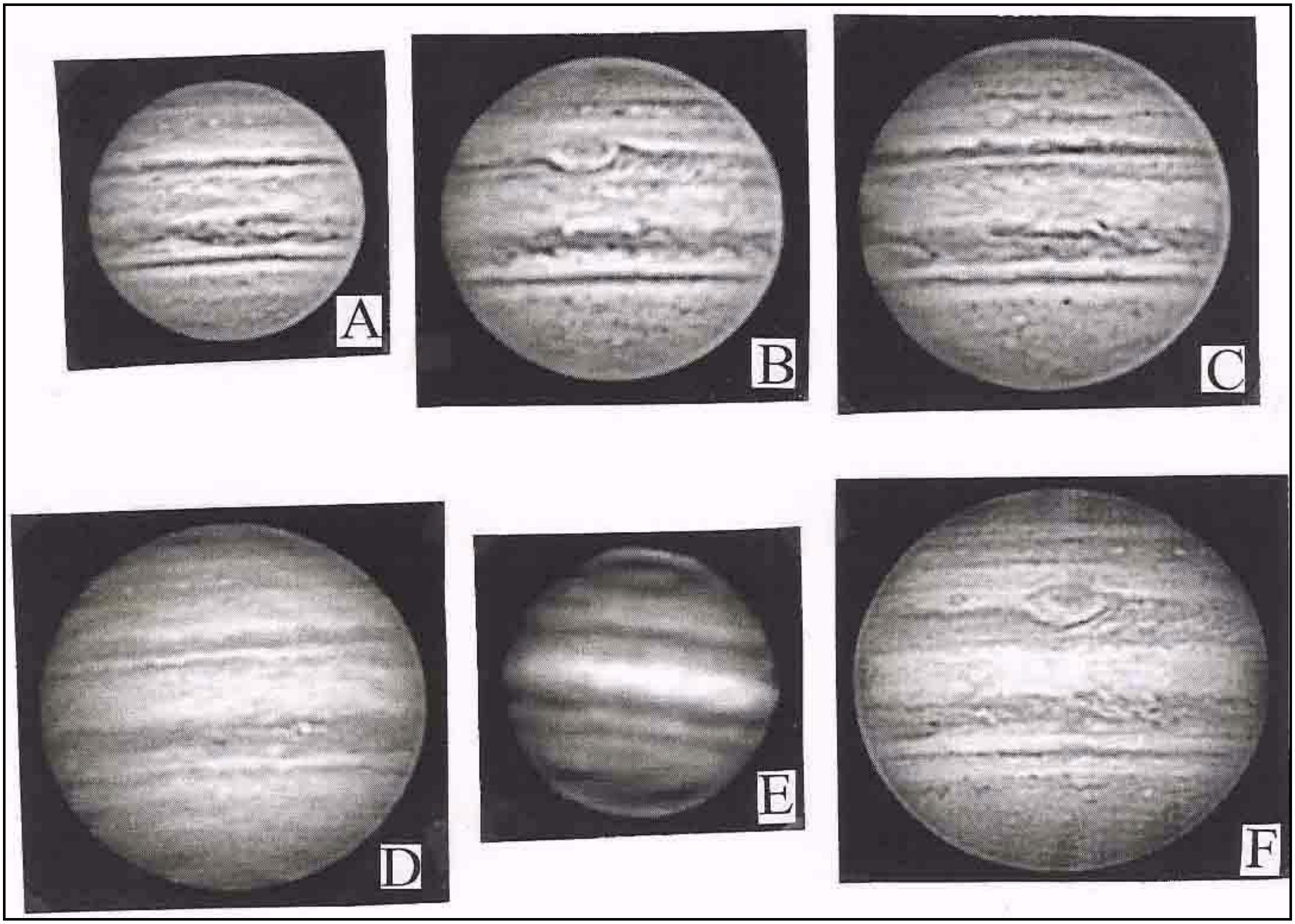

Figure 3: Images of Jupiter made during the 2000-2001 Apparition. A: Aug. 20, 2000, 08:49 UT by Don Parker, 0.41-m RL (λ_I = 307°, λ_{II} = 314°); B: Sep. 9, 2000, 08:55 UT by Don Parker, 0.41-m RL (λ_I = 228°, λ_{II} = 083°); C: Oct. 5, 2000, 06:33 UT by Don Parker, 0.41-m RL (λ_I = 289°, λ_{II} = 305°); D: Oct. 17, 2000, 03:37 UT by Antonio Cidadao, 0.25-m SC (λ_I = 277°, λ_{II} = 204°); E: Oct. 29, 2000, 04:04 UT methane-band image by Brian Colville, 0.30-m SC (λ_I = 030°, λ_{II} = 225°); F: Dec. 11, 2000, 00:14 UT by Don Parker, 0.41-m RL (λ_I = 205°, λ_{II} = 073°).

Region II: South Polar Region to the South Tropical Zone

On several occasions in 1999-2000, the SPR was relatively bright and was bordered by a dark belt; *see* Figures 2C, 2D and 2E. This dark border was less distinct in 2000-2001; *see* Figure 3. No equivalent dark border was present near the NPR. Brian Cudnik apparently observed this dark border; *see* Figure 1A. The SPR (south of the dark band) was brighter than the NPR in 1999-2000; however, if the dark band is counted as part of the SPR then both polar regions had a nearly equal brightness. The south limb was usually brighter than the north limb in 2000-2001. Both polar regions had a gray color in late 1999 and a gray color with a little brown in late 2000.

One white oval (A2) in 1999-2000 was at 60°S and had a drift rate of -13°.6/30 days, (System II) which is similar to that of white oval A1 in 2000-2001, (-19°.1/30 days). These drift rates are similar to that of A2 in 1998 (Schmude and McAnally, 2005) and to the SPC spot reported by Rogers *et al.* (2004a, 202) in 2000-2001.

Three white ovals, A1, A3 and A5, in the SSSTC were followed over short periods of time in 1999-2000; *see* Figure 4. Drift rates (deg./30 days) of +3.1 (A1), -34.7 (A3) and -3.7 (A5) were measured. No reliable wind speed was computed because of the large difference in drift rates.

Six different SSTB white ovals (B1-B6) had a mean drift rate of -26°.7/30 days in 1999-2000; the corresponding mean in 2000-2001 for 7 white ovals (B1-B7) was -25°.4/30 days. These drift rates are close to historical values (Rogers, 1995, 238-239).

Six features in the STC, including four white ovals (C1, C2, BE and FA) and two dark spots (C3 and C4), had a mean drift rate of -13°.4/30 days in 1999-2000. Figure 6A shows the distance between the

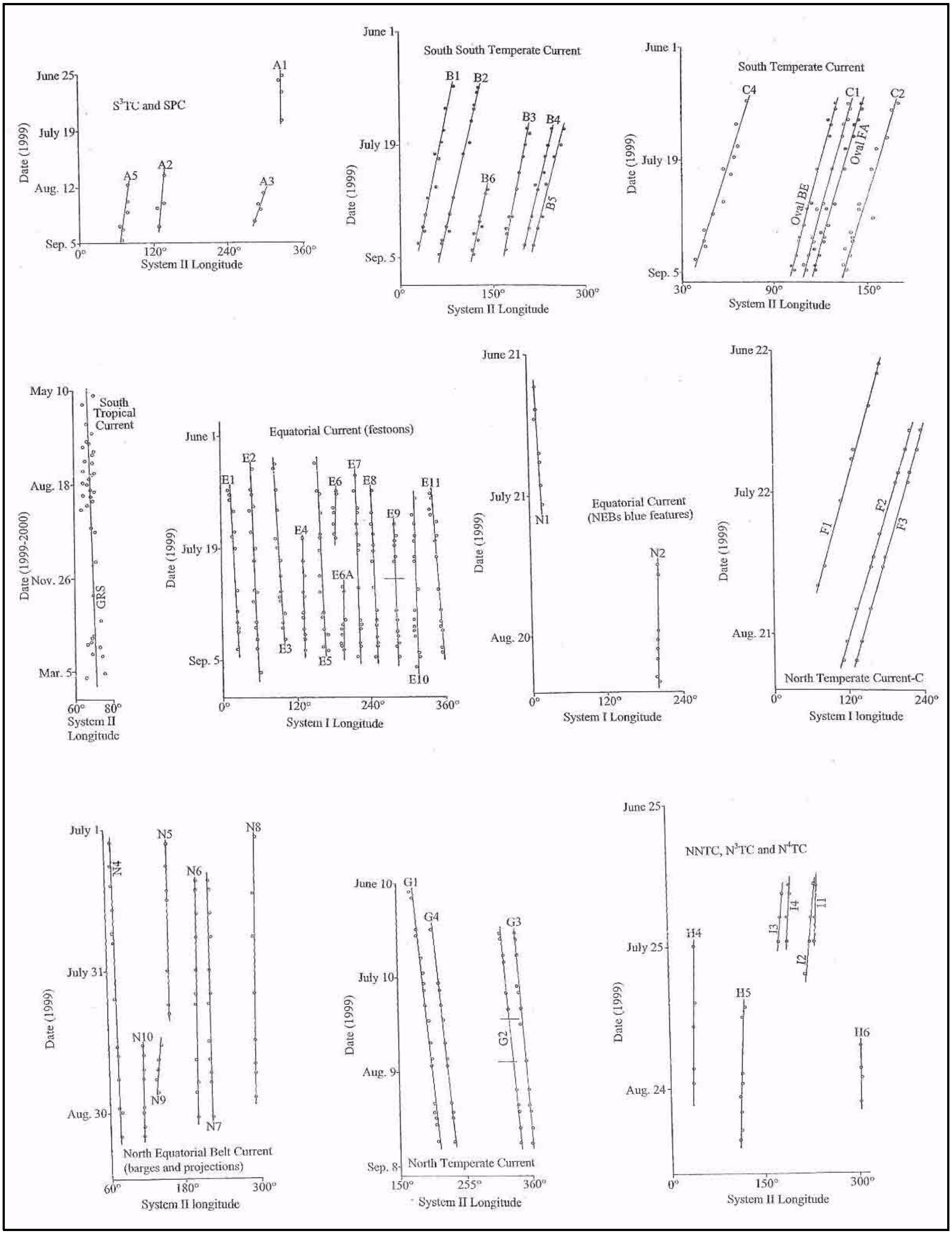

Figure 4: Longitudes for features during the 1999-2000 Apparition. The lines are longitude estimates taken from drawings or from images that barely show the feature of interest.

centers of ovals FA and BE (solid circles) in 1998-2000. Before Feb. 1998, the distance between Oval FA and the point between ovals BC and DE are plotted (open circles). During late 1999, the distance between FA and BE dropped to 14° in Sep. 1999 and then the two ovals grew farther apart, reaching a separation of 16° in late October before once again moving closer together until their merger in March 2000. This oscillation in separation also occurred for ovals BC and DE during most of the 1990s (Schmude and McAnally, 2005). What caused these oscillations?

Ovals BE and FA transited the GRS in Nov., 1999 (see Figure 1E); this is about the time that FA began to move towards BE. Transits with the GRS in 1990, 1992, 1995 and 1997 appeared to have caused oval DE to move towards BC. The writer believes that transits with the GRS caused the distances between the STB ovals to oscillate; further-more, he feels that GRS transits hastened the merger of ovals BE and FA.

Two white ovals, BA and C1, and three dark spots, C2, C3 and C4, all followed the STC in late 2000 and had a mean drift rate of –15°.9/30 days. Oval BA had a drift rate of -11°.8/30 days in 2000-2001, which is less negative (slower) than those of FA and BE in 1999-2000; this slowdown may be due to BA having passed the GRS (Rogers, 1995, 226).

Oval BA had an area of $67 \pm 9 \times 10^6$ km^2, which is 64 percent of the sum of the areas of ovals BE and FA in 1999-2000. Sanchez-Lavega *et al.* (1999, 121) report dimensions for the white portions of ovals BE, BC and DE and from this, I computed that BE had an area of about 71 percent of the combined areas of ovals BE and DE. The SSTB ovals B1 and B6 merged to form B8 in 1992 and once again, Oval B8 had an area of about 70 percent of the sum of the areas of B1 and B6 (Schmude, 2002a, 27). It thus appears that, when two ovals merge, the resulting oval has an area of about 70 percent of the sum of the areas of the two original ovals.

A notch in the SEBs (S1) was at λ_{II} 168°, 169°, 168°, 165°, 171° and 165° on June 26.8, July 3.9, July 8.8, July 13.8, July 15.9 and July 23.8, 1999, respectively.

Table 4: Mean Planetographic Latitudes of Belts on Jupiter, 1999-2000 and 2000-2001 apparitions[a]

Belt	Planetographic latitude (Visible light) 1999-2000	Planetographic latitude (Visible light) 2000-2001
SSSSTBs	53°.5S±1°	---
SSSSTBn	52°.0S±1°	52°.7S±1°
SSSTBs	44°.7S±1°	46°.3S±1°
SSSTBn	41°.9S±1°	43°.6S±1°
SSTBs	38°.3S±1°	39°.0S±1°
SSTBn	35°.6S±1°	36°.7S±1°
STBs	31°.0S±1°	31°.0S±1°
STBn	27°.5S±1°	27°.5S±1°
(S comp.) SEBs	21°.8S±0°.5	20°.9S±0°.5
(S comp.) SEBn	*	15°.8S±0°.5
(N comp.) SEBs	*	12°.6S±1°
(N comp.) SEBn	6°.7S±0°.5	8°.2S±1°
EBc	0°.9S±0°.5	1°.7S±0°.5
NEBs	7°.5N±0°.5	8°.4N±0°.5
NEBn	18°.3N±0°.5	19°.2N±1°
NTBs	25°.2N±0°.5	24°.9N±0°.5
NTBn	28°.8N±0°.5	28°.9N±0°.5
NNTBs	37°.1N±0°.5	34°.5N±1°
NNTBn	40°.2N±0°.5	40°.4N±0°.5
NNNTBs	44°.9N±1°	44°.7N±1°.5
NNNTBn	48°.0N±1°	51°.0N±1°.5
NNNNTBs	54°.2N±1°	---
NNNNTBn	57°.2N±1°	---
GRS	22°.6S±0°.5	22°.9S±0°.5

[a]The north and south edge of the belts are designated by a small “n” or “s”; for example, the north edge of the north equatorial belt is called “NEBn”. A small c means “center”.

* The SEB often appeared as one solid belt in 1999-2000; at other times two components were visible but with diffuse borders.

This notch had a drift rate of -2°.7/30 days, which is close to that of the GRS.

A dark smudge in the STrC developed into a dark oval (C5) in late 2000. This feature had a drift rate of +6°.2/30 days, which is slower than the GRS.

Region III: South Equatorial Belt

The SEB had a brown color in 1999-2000 and 2000-2001. The SEB was wider on the western side of the GRS than on the eastern side; see Figures 2F, 3B and 3F. On many occasions in 2000-2001, a series of white ovals spaced 5-10 degrees apart lay between the SEBn and the EZ; see Figures 3B and 3F.

One bright spot, S2, near the center of the SEB and just west of the GRS was at λ_{II} = 085°.5, 083°.4 and 076°.6 on Aug. 5.9, Aug. 6.8 and Aug. 10.9, 1999, respectively; the drift rate for this feature was -52°.4/30 days. This rate is consistent with similar features in 2001-2002 (Schmude, 2003b, 47).

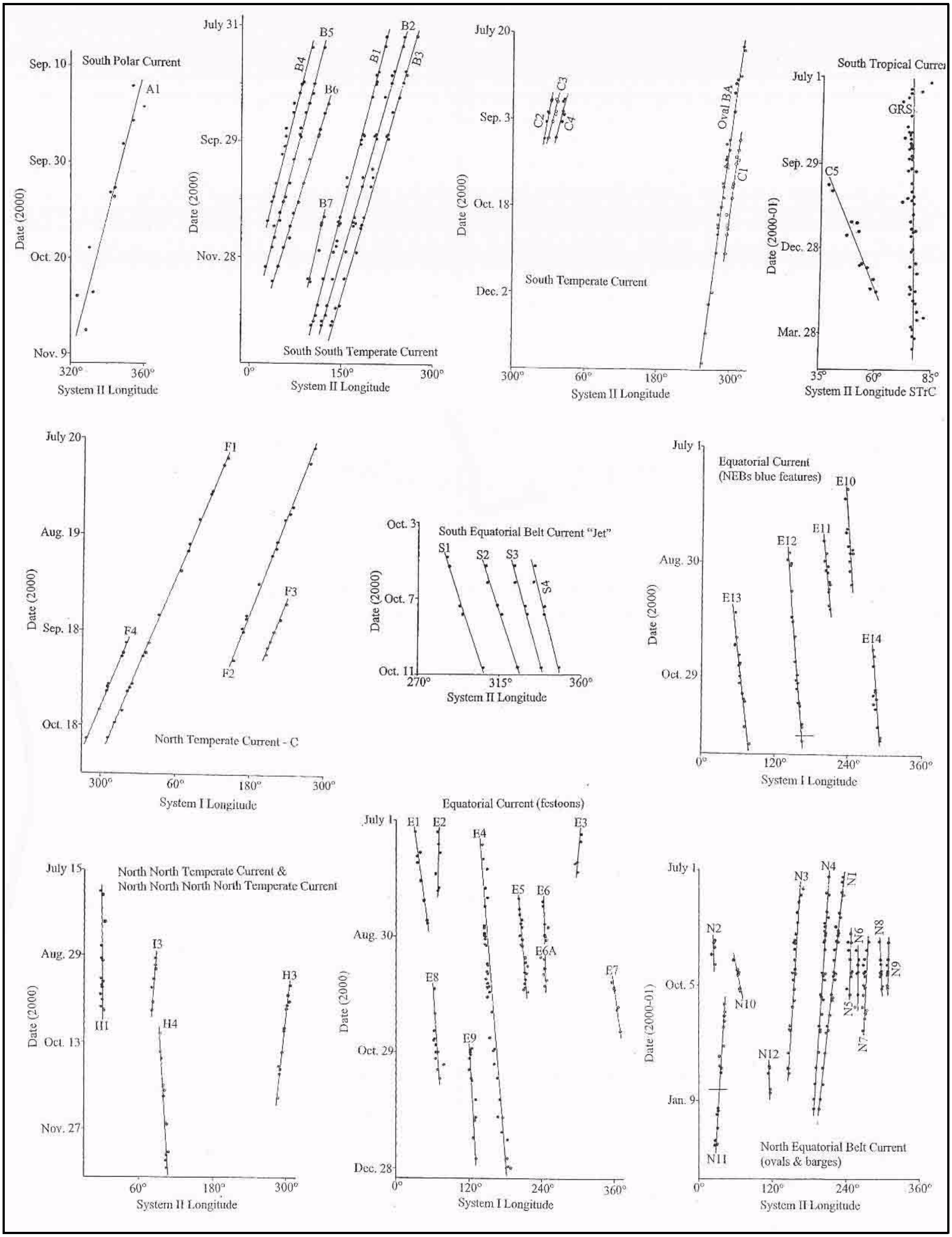

Figure 5: Longitudes for features during the 2000-2001 Apparition. Symbols are the same as in Figure 4.

Table 5: Dimensions of White Ovals During the 1999-2000 Apparition (in visible light except where noted)

Feature	Dimension (km)		Aspect[a]	Area[a] (10^6 km^2)
	east-west	north-south		
A2	5000	5000	1.00	19±3
A1	4800	4700	0.96	18±3
A3	4400	4100	0.94	14±2
A5	4800	4500	0.95	17±2
B1	6100	4400	0.71	21±3
B2	4900	4100	0.84	16±2
B3	4600	4400	0.96	16±2
B4	4200	3600	0.84	12±2
B5	4200	3800	0.90	12±2
B6	4600	4200	0.91	15±2
Oval BE	11,100	8400	0.76	73±10
Oval FA	7800	5000	0.64	31±4
C1	5900	5400	0.90	25±4
C2	3600	3600	1.00	10±1
GRS	20,800	11,700	0.56	191±11
GRS (Methane-band light)	19,800	11,100	0.56	173±8

[a]The aspect is the north-south dimension divided by the east-west dimension. All areas were computed by assuming an elliptical shape. All east-west and north-south dimensions have uncertainties of 10 percent except for methane-band data. The dimensions are rounded to the nearest 100 km. Aspects are computed from the mean dimensions and thus may be slightly different from values computed from the rounded dimensions listed in the tables.

Four tiny white ovals (S1-S4), surrounded by dark borders, developed on the southern edge of the SEB in late 2000; see Figure 3C. These ovals changed very quickly and so they were followed for just a few days. These ovals had a mean System II drift rate of +96°.1/30 days, which is similar to the rate measured by Rogers *et al.* (2004a, 203) in the "SEBs jet". I have accordingly named the current carrying S1-S4 the "SEBs jet".

Region IV: Equatorial Zone

The EZn was usually darker than the EZs in 1999-2000; see Figure 2. In 1999-2000, the EZs had a white color whereas the EZn had a gray color with blue and brown hues. In 2000-2001, both components of the EZ had a nearly white color. The EB had a gray color in 1999-2000 and 2000-2001.

The mean System I drift rate of the festoons in 1999-2000 was +2°.3/30 days, which is close to the mean drift rate of the NEBs blue features (+2°.9/30 days). In 2000-2001, the corresponding drift rate was +5°.5/30 days, which is similar to the rate of the NEBs blue features (+8°.6/30 days).

Region V: The North Equatorial Belt

The NEB was brown in 1999-2000 and 2000-2001. The mean width of the NEB for 1999-2000 and 2000-2001 was 10°.8, which is close to the historical mean width (Peek, 1981, 67).

The mean drift rate for the two NEB ovals (N8 and N10) in 1999-2000 was -3°.4/30 days; the corresponding mean for the three ovals in 2000-2001 was +0°.5/30 days. The mean latitudes for these ovals were 18°.4N and 18°.3N for 1999-2000 and 2000-2001 respectively. Both latitudes are close to the historical mean of 19°.3N (Rogers, 1995, 399). Figure 3D shows the white oval N1 at λ_{II} = 217°.

The mean drift rate of the NEB barges was +3°.4/30 days in 1999-2000 and -0°.3/30 days in 2000-2001. Figure 3D shows the barge N4 at λ_{II} = 202° in late 2000. The mean planetographic latitudes of the NEB barges in 1999-2000 and 2000-2001 were: 17°.8N and 17°.5N respectively; these latitudes are close to the corresponding latitudes in 1997 (16°.5N) and 1998 (17°.2N) (Schmude and McAnally, 2005).

Region VI: North Tropical Zone to the North Polar Region

The NTB and NNTB both had a brown color in both the 1999-2000 and 2000-2001 Apparitions. The NTrZ had a yellow-white color during both apparitions while the NTZ had a gray-yellow color in late 1999 and a yellow-white color a year later.

Three dark spots, G1-G3, and one white oval, G4, in the NTB had a mean drift rate of +13°.1/30 days in 1999-2000, which is consistent with the NTC (Rogers, 1995, 102-103).

Three dark bumps on the NTBn in late 1999 (F1-F3) had a mean System I drift rate of -65°.9/30 days and four dark bumps (F1-F4) on the NTBs had a mean drift rate of -62°.7/30 days in 2000-2001. Both drift rates are consistent with the NTC-C (Rogers, 1995, 107), (Peek, 1981, 84).

Four white ovals in 1999-2000 (H1, H4-H6) had a mean latitude of 42°.2N and a mean drift rate of -4°.7/30. These ovals were in the NNTZ and their drift rate is close to that of the NNTC (Peek, 1981, 77 and Rogers, 1995, 88-89). One dark bar H1 and two white ovals H3 and H4 were in the NNTB or NNTZ in late 2000; the mean drift rate of these three was -1°.7/30 days, which is consistent with the NNTC.

One dark spot (H2) on the NNTBs had a mean drift rate of -78°.3/30 days in 2000-2001, which is consistent with the NNTC-B (Peek, 1981, 78).

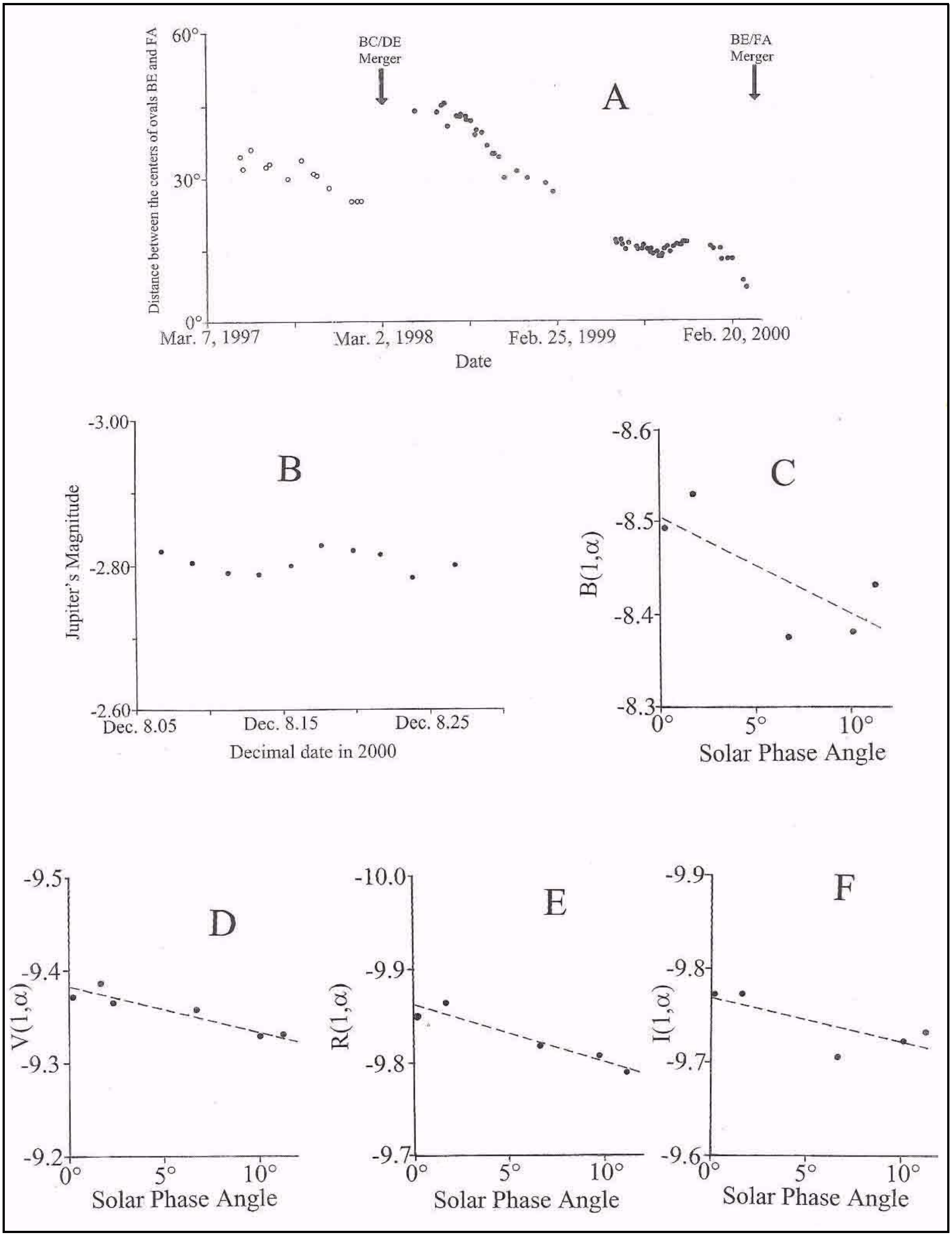

Figure 6: Miscellaneous plots. A: A graph showing the separation between ovals BE and FA. B: A graph showing Jupiter's V-magnitude during Dec. 8, 2000. C-F: graphs of the normalized magnitude of Jupiter plotted against the solar phase angle of that planet.

Table 6: Dimensions of White Ovals During the 2000-2001 Apparition (in visible light except where noted)

Feature	Dimension (km)		Aspect[a]	Area (10^6 km^2)
	east-west	north-south		
A1	4700	4900	1.04	18±3
B1	6100	4900	0.80	23±3
B2	5500	5000	0.92	21±3
B3	4800	4600	0.97	17±2
B4	5100	5000	0.99	20±3
B5	4900	4900	1.00	19±3
B6	4800	4400	0.91	16±2
B7	4000	4100	1.03	13±2
Oval BA	10,600	8000	0.76	67±9
C1	4300	4200	0.97	14±2
S2	3700	2400	0.65	7±1
S3	3300	1800	0.54	5±1
S4	3700	2300	0.61	7±1
N1	8000	4300	0.54	27±4
N2	6200	4700	0.76	23±3
N12	4900	3300	0.68	13±2
H3	4700	4500	0.96	16±2
H4	3600	3500	0.97	10±1
GRS (Methane-band light)	20,000	12,100	0.61	190±19

[a]Please see the note in Table 4 about the aspect and uncertainties.

One white oval, I3, at 55°.2N had a drift rate of -7°.1/30 days in 2000-2001. This feature is in the N[4]TC (Rogers, 1990, 88). Figure 3C shows I3 at λ_{II} = 290°.

One white oval, I1, in 1999-2000 was at 60°.4N which is in the north polar current. This feature had a drift rate of -12°.2/30 days.

Wind Speeds

Wind speeds are listed in Tables 13A (1999-2000) and 13B (2000-2001) and are given with respect to System III longitude. Wind speeds and corresponding uncertainties were computed in the same way as in Schmude (2002a, 30-31; 2003a, 50).

Photoelectric Photometry

The writer used an SSP-3 solid-state photometer along with filters that were transformed to the Johnson B, V, R and I system (where B stands for blue, V for visual or green, R for red and I for near infrared) and a 0.09-m Maksutov telescope to make all magnitude measurements of Jupiter in late 2000. More information about the photometer and telescope can be found elsewhere (Optec, 1997 and Schmude, 2002b, 105). All magnitude measurements were corrected for both extinction and color transformation. The color corrections were computed in the same way as in Hall and Genet (1988, 200). The comparison star for all measurements in 2000 was Epsilon-Tauris. The magnitude measurements are summarized in Table 14. The same technique used in Schmude and Lesser (2000, 67) was used in determining the solar phase angle coefficients, c_x, and the normalized magnitudes at a solar phase angle of 0°, X(1,0). The c_x and X(1,0) values are summarized in Table 15. Uncertainties in Table 14 are computed in the same way as in Schmude (1998, 178-179).

On Dec. 8, the writer measured Jupiter's brightness over a period of a few hours; the results are shown in Figure 6B. There were small changes in Jupiter's brightness as that planet rotated. Plots of the normalized magnitudes versus the solar phase angle, α, are shown in Figures 6C-6F for the B, V, R and I filters respectively. The photometric constants in 2000 are very close to those in the previous apparition (Schmude and Lesser, 2000, 67).

Shape of Jupiter

The flattening value, F, of Jupiter was measured in the same way as in Schmude (2003b, 46). Essentially, a positive F-value means that Jupiter has a more nearly spherical shape than predicted, whereas a negative value means that Jupiter has a more elliptical shape than predicted. The mean F-values in late 1999 for the RGB and methane-band (CH_4) images were: -0.004 ± 0.002 and 0.027 ± 0.003 respectively. The mean F values for late 2000 and early 2001 for the blue, green, red, RGB, near infrared and CH_4 images were: -0.006 ±0.003, -0.004 ±0.003, 0.002 ±0.003, -0.004 ±0.003, 0.011 ±0.002 and 0.045 ±0.003 respectively. The effective wavelength of the CH_4 images was 889 nanometers.

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Table 7: Drift Rates of Features Between the South Pole and the Northern Portion of the SEB, 1999-2000 Apparition

I.D.	Number of Points	Time Interval (1999/2000)	Planetographic Latitude	Drift Rate (deg./30 days) (System II)	Rotation Period
South Polar Current					
A2	4	Aug. 06 – Aug. 28	60°S	-13.6	9h 55m 22s
South South Temperate Current					
B1	12	June 23 – Aug. 29	40°.0S	-24.1	9h 55m 08s
B2	15	June 24 – Sep. 03	40°.6S	-27.4	9h 55m 03s
B3	11	July 11 – Sep. 01	40°.5S	-24.4	9h 55m 07s
B4	9	July 11 – Aug. 30	40°.0S	-27.6	9h 55m 03s
B5	8	July 11 – Aug. 30	40°.3S	-30.7	9h 54m 59s
B6	9	Aug. 06 – Sep. 03	40°.5S	-25.8	9h 55m 05s
	Mean		*40°.3S*	*-26.7*	*9h55m 04s*
South Temperate Current					
BE	15	June 24 – Sep. 03	32°.2S	-12.6	9h 55m 24s
FA	17	June 24 – Sep. 03	33°.1S	-13.3	9h 55m 23s
C1	13	June 24 – Sep. 03	31°.0S	-12.8	9h 55m 23s
C2	14	June 26 – Sep. 03	32°.7S	-13.8	9h 55m 22s
C3	12	June 24 – Sep. 03	28°.3S	-12.8	9h 55m 23s
C4	12	June 23 – Aug. 29	33°.4S	-15.0	9h 55m 20s
	Mean		*31°.8S*	*-13.4*	*9h 55m 22s*
South Tropical Current					
GRS	38	May 13 – Mar. 12	22°.6S	+0.2	9h 55m 41s
S1	6	June 26 – July 23	21°.8S	-2.7	9h 55m 37s
South Tropical Current (White spot following the GRS)					
S2	3	Aug. 05 – Aug. 10	13°.1S	-52.3	9h 54m 29s

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Table 8: Drift Rates of Features within the Equatorial Zone and the North Temperate Current - C, 1999-2000 Apparition of Jupiter

I.D.	Number of Points	Time Interval (1999)	Planetographic Latitude	Drift Rate (deg./30 days) (System I)	Rotation Period
Equatorial Current (festoons)					
E1	13	June 23 – Aug. 30	7°.5N	+5.1	9h 50m 37s
E2	16	June 14 – Sep. 10	7°.5N	+3.4	9h 50m 35s
E3	15	June 12 – Aug. 26	7°.5N	+5.0	9h 50m 37s
E4	11	July 14 – Aug. 31	7°.5N	+0.7	9h 50m 31s
E5	15	June 12 – Aug. 31	7°.5N	+4.7	9h 50m 36s
E6	7	June 24 – July 14	7°.5N	-5.1	9h 50m 23s
E6A	9	Aug. 04 – Aug. 31	7°.5N	-2.1	9h 50m 27s
E7	15	June 17 – Sep. 03	7°.5N	+2.1	9h 50m 33s
E8	15	June 24 – Sep. 03	7°.5N	+3.6	9h 50m 35s
E9	14	July 08 – Sep. 03	7°.5N	+2.3	9h 50m 33s
E10	16	June 27 – Sep. 08	7°.5N	+0.6	9h 50m 31s
E11	15	June 24 – Sep. 01	7°.5N	+7.2	9h 50m 40s
	Mean		*7°.5 N*	*+2.3*	*9h 50m 33s*
Equatorial Current (NEBs Blue features)					
N1	7	June 27 – July 22	7°.5N	+9.7	9h 50m 43s
N2	6	Aug. 04 – Aug. 29	7°.5N	-4.0	9h 50m 25s
	Mean		*7°.5 N*	*+2.9*	*9h 50m 34s*
North Temperate Current - C					
F1	8	June 24 – Aug. 10	25°.2N	-64.2	9h 49m 04s
F2	10	July 08 – Aug. 26	25°.2N	-68.0	9h 48m 59s
F3	9	July 08 – Aug. 26	25°.2N	-65.5	9h 49m 02s
	Mean		*25°.2 N*	*-65.9*	*9h 49m 02s*

Table 9: Drift Rates of Features Between the North Equatorial Belt and the North Pole for the 1999-2000 Apparition

I.D.	Number of Points	Time Interval (1999)	Planetographic Latitude	Drift Rate (deg./30 days) (System I)	Rotation Period
North Equatorial Belt (barges)					
N4	13	July 03 – Sep. 03	17°.8N	+3.4	9h 55m 45s
E2	16	June 14 – Sep. 10	7°.5N	+3.4	9h 50m 35s
North Equatorial Belt Current (ovals)					
N8	8	July 02 – Aug. 26	18°.5N	-4.5	9h 55m 35s
N10	8	Aug. 15 – Sep. 03	18°.4N	-2.3	9h 55m 38s
	Mean		*18°.4N*	*-3.4*	*9h 55m 36s*
North Equatorial Belt Current (projections)					
N3	3	June 12 – June 24	18°.3N	+4.7	9h 55m 47s
N5	7	July 03 – Aug. 08	18°.3N	-0.5	9h 55m 40s
N6	11	July 11 – Aug. 30	18°.3N	-5.0	9h 55m 34s
N7	12	July 11 – Aug. 30	18°.3N	-2.7	9h 55m 37s
N9	5	Aug. 15 – Aug. 25	18°.3N	-23.3	9h 55m 09s
	Mean (excluding feature N9)		*18°.3N*	*-0.9*	*9h 55m 40*
North Temperate Current					
G1	18	June 12 – Aug. 30	30°.8N	13.8	9h 56m 00s
G2	11	June 25 – Aug. 31	31°.3N	13.0	9h 55m 59s
G3	13	June 25 – Aug. 31	30°.9N	11.2	9h 55m 56s
G4	12	June 24 – Aug. 30	30°.2N	14.3	9h 56m 00s
	Mean		*30°.8N*	*13.1*	*9h 55m 59s*
North North Temperate Current					
H1	5	June 26 – July 22	42°.2N	+1.6	9h 55m 43s
H4	5	July 24 – Aug. 22	42°.7N	-6.0	9h 55m 32s
H5	8	Aug. 06 – Sep. 03	42°.1N	-10.2	9h 55m 27s
H6	4	Aug. 14 – Aug. 26	41°.8N	-4.0	9h 55m 35s
	Mean		*42°.2N*	*-4.7*	*9h 55m 34s*
North North North Temperate Current					
I2	4	July 11 – July 30	47°.6N	-28.2	9h 55m 02s
I3	3	July 13 – July 23	46°.0N	-18.0	9h 55m 16s
I4	3	July 11 – July 23	46°.5N	-12.3	9h 55m 24s
	Mean		*46°.7N*	*-19.5*	*9h 55m 14s*
North Polar Current					
I1	3	July 11 – July 23	60°.4N	-12.2	9h 55m 24s

Table 10: Drift Rates of Features Between the South Pole and the Northern Portion of the South Equatorial Belt for the 2000-2001 Apparition

I.D.	Number of Points	Time Interval (1999)	Planetographic Latitude	Drift Rate (deg./30 days) (System I)	Rotation Period
South Polar Current					
A1	11	Sep. 14 – Nov. 04	58°.6S	-19.1	9h 55m 15s
South South Temperate Current					
B1	26	Aug. 05 – Jan. 02	40°.1S	-24.3	9h 55m 07s
B2	21	Aug. 05 – Jan. 02	40°.8S	-26.8	9h 55m 04s
B3	21	Aug. 05 – Jan. 02	40°.4S	-27.9	9h 55m 03s
B4	15	Aug. 11 – Nov. 09	40°.3S	-23.8	9h 55m 08s
B5	18	Aug. 11 – Dec. 03	40°.5S	-24.6	9h 55m 07s
B6	14	Sep. 09 – Dec. 11	40°.6S	-29.0	9h 55m 01s
B7	7	Nov. 07 – Dec. 11	40°.3S	-21.6	9h 55m 11s
	Mean		*40°.4S*	*-25.4*	*9h 55m 06s*
South Temperate Current					
OvalBA	29	July 26 – Jan. 07	32°.0S	-11.8	9h 55m 25s
C1	13	Sep. 13 – Nov. 11	33°.5S	-12.8	9h 55m 23s
C2	6	Aug. 24 – Sep. 13	32°.9S	-21.4	9h 55m 11s
C3	6	Aug. 24 – Sep. 13	32°.4S	-16.6	9h 55m 18s
C4	6	Aug. 24 – Sep. 13	32°.4S	-17.2	9h 55m 17s
	Mean (excluding feature N9)		*32°.6S*	*-15.9*	*9h 55m 19s*
South Tropical Current					
GRS	57	July 07 – Apr. 15	22°.9S	+0.3	9h 55m 41s
C5	24	Oct. 10 – Feb. 14	22°.7S	+6.2	9h 55m 49s
	Mean		*22°.8S*	*+3.3*	*9h 55m 45s*
South Equatorial Current ("Jet")					
S1	5	Oct. 04 – Oct. 10	20°.9S	+103.6	9h 58m 03s
S2	5	Oct. 05 – Oct. 10	20°.9S	+106.4	9h 58m 07s
S3	5	Oct. 05 – Oct. 10	20°.9S	+90.4	9h 57m 45s
S4	5	Oct. 05 – Oct. 10	20°.9S	+84.0	9h 57m 36s
	Mean		*20°.9S*	*+96.1*	*9h 57m 53s*

Table 11: Drift Rates of Features Within the Equatorial Zone and the Northern Temperate Current - C for the 2000-2001 Apparition

I.D.	Number of Points	Time Interval (2000)	Planetographic Latitude	Drift Rate (deg./30 days) (System I)	Rotation Period
Equatorial Current (festoons)					
E1	8	July 07 – Aug. 24	8°.4N	+11.8	9h 50m 46s
E2	6	July 07 – Aug. 06	8°.4N	-2.0	9h 50m 27s
E3	5	July 07 – July 27	8°.4N	-10.5	9h 50m 16s
E4	39	July 13 – Dec. 27	8°.4N	+7.8	9h 50m 41s
E5	21	Aug. 10 – Sep. 27	8°.4N	+8.3	9h 50m 41s
E6	7	Aug. 12 – Aug. 31	8°.4N	+6.8	9h 50m 39s
E6A	6	Sep. 09 – Sep. 24	8°.4N	+9.2	9h 50m 43s
E7	6	Sep. 22 – Oct. 18	8°.4N	+14.9	9h 50m 50s
E8	12	Sep. 26 – Nov. 11	8°.4N	+3.6	9h 50m 35s
E9	13	Oct. 27 – Dec. 22	8°.4N	+5.2	9h 50m 37s
	Mean		*8°.4N*	*+5.5*	*9h 50m 38s*
NEBs blue features					
E10	11	July 22 – Sep. 10	8°.4N	+6.7	9h 50m 39s
E11	12	Aug. 18 – Sep. 23	8°.4N	+10.9	9h 50m 45s
E12	20	Aug. 25 – Dec. 01	8°.4N	+7.1	9h 50m 40s
E13	13	Sep. 26 – Dec. 03	8°.4N	+10.6	9h 50m 44s
E14	12	Oct. 14 – Nov. 30	8°.4N	+7.6	9h 50m 40s
	Mean		*8°.4N*	*+8.6*	*9h 50m 42s*
North Temperate Current - C					
F1	18	July 26 – Oct. 22	24°.9N	-63.8	9h 49m 05s
F2	14	July 22 – Sep. 27	24°.9N	-60.0	9h 49m 09s
F3	6	Sep. 09 – Sep. 25	24°.9N	-63.5	9h 49m 05s
F4	9	Sep. 22 – Oct. 22	24°.9N	-63.3	9h 49m 05s
	Mean		*24°.9N*	*-62.7*	*9h 49m 06s*

Table 12: Drift Rates of Features Between the North Equatorial Belt and the North Pole for the 2000-2001 Apparition

I.D.	Number of Points	Time Interval (1999)	Planetographic Latitude	Drift Rate (deg./30 days) (System II)	Rotation Period
North Equatorial Belt (barges)					
N3	26	July 16 – Dec. 17	17°.0N	-3.9	9h 55m 35s
N4	29	July 07 – Jan. 16	18°.1N	-3.9	9h 55m 35s
N5	10	Aug. 23 – Oct. 13	16°.5N	+0.2	9h 55m 41s
N6	7	Sep. 05 – Oct. 22	19°.4N	-1.8	9h 55m 38s
N7	16	Aug. 29 – Nov. 11	16°.2N	-1.7	9h 55m 38s
N8	9	Aug. 29 – Oct. 07	19°.3N	+2.9	9h 55m 45s
N9	8	Aug. 29 – Oct. 07	16°.2N	-1.4	9h 55m 39s
N10	6	Sep. 14 – Oct. 09	17°.8N	+11.2	9h 55m 56s
N11	17	Oct. 21 – Feb. 14	16°.7N	-3.9	9h 55m 35s
	Mean		*17°.5N*	*-0.3*	*9h 55m 40s*
North Equatorial Belt Current (ovals)					
N1	31	July 07 – Jan. 16	17°.3N	-6.2	9h 55m 32s
N2	5	Aug. 29 – Sep. 18	18°.6N	+2.5	9h 55m 44s
N12	5	Dec. 11 – Jan. 02	19°.1N	+5.2	9h 55m 48s
	Mean		*18°.3N*	*+0.5*	*9h 55m 41s*
North North Temperate Current B					
H2	6	Aug. 24 – Sep. 18	35°.4N	-78.3	9h 53m 54s
North North Temperate Current					
H1	14	July 26 – Sep. 26	38°.9N	-0.1	9h 55m 41s
H3	12	Sep. 13 – Nov. 11	42°.1N	-10.5	9h 55m 26s
H4	13	Oct. 08 – Dec. 17	41°.5N	+5.6	9h 55m 48s
	Mean		*40°.8N*	*-1.7*	*9h 55m 38s*
North North North North Temperate Current					

Table 13A: Mean Drift Rates, Rotation Periods and Wind Speeds for Several Currents on Jupiter, 1999-2000 Apparition

Current	Feature(s)	Drift Rate (deg/30 days)			Rotation Period	Wind Speed (m/s)
		Sys. I	Sys. II	Sys. III		
S. Polar Cur.	A2	+215.3	-13.6	-5.6	9h 55m 22s	1.4 ±2*
SS Temp. Cur.	B1-B6	+202.2	-26.7	-18.7	9h 55m 04s	7.0 ±0.4
S Temp Cur.	Ovals BE & FA, C1-C4	+215.5	-13.4	-5.4	9h 55m 22s	2.2±0.2
S Trop. Cur. (GRS)	GRS	+229.1	+0.2	+8.2	9h 55m 41s	-3.7±0.2*
S Trop. Cur.	S1	+226.2	-2.7	+5.3	9h 55m 37s	-2.4±0.1*
SEB Cur (following GRS)	S2	+176.6	-52.3	-44.3	9h 54m 29s	20.8±1*
Eq. Cur. (festoons)	E1-E11	+2.3	-226.6	-218.6	9h 50m 33s	104.3±0.5
Eq. Cur. (NEBs bluefeatures)	N1, N2	+2.9	-226.0	-218.0	9h 50m 34s	104.0±2.3
NEB Cur. (barges)	N4	+232.3	+3.4	+11.4	9h 55m 45s	-5.2±1*
NEB Cur. (ovals)	N8, N10	+225.5	-3.4	+4.6	9h 55m 36s	-2.1±0.4
NEB Cur. (proj.)	N3, N5-N7	+228.0	-0.9	+7.1	9h 55m 40s	-3.3±0.9
N Temp. Cur. C	F1-F3	-65.9	-294.8	-286.8	9h 49m 02s	126.2±0.5
N Temp. Cur.	G1-G4	+242.0	+13.1	+21.1	9h 55m 59s	-8.9±0.3
NN Temp. Cur.	H1, H4-H6	+224.2	-4.7	+3.3	9h 55m 34s	-1.2±0.8
NNN Temp. Cur.	I2-I4	209.4	-19.5	-11.5	9h 55m 14s	3.9±1.3
NP Cur.	I1	+216.7	-12.2	-4.2	9h 55m 24s	1.0±2*

Table 13B: Mean Drift Rates, Rotation Periods and Wind Speeds for Several Currents on Jupiter, 2000-2001 Apparition

Current	Feature(s)	Drift Rate (deg/30 days)			Rotation Period	Wind Speed (m/s)
		Sys. I	Sys. II	Sys. III		
S Polar Cur.	A1	+209.8	-19.1	-11.1	9h 55m 15s	2.9±2*
SS Temp. Cur	B1-B7	+203.5	-25.4	-17.4	9h 55m 06s	6.5±0.4
S Temp. Cur.	Oval BA, C1-C4	+213.0	-15.9	-7.9	9h 55m 19s	3.3±0.7
S Trop. Cur.	GRS	+229.2	+0.3	+8.3	9h 55m 41s	3.7±0.2*
S Trop. Cur.	C5	+235.1	+6.2	+14.2	9h 55m 49s	-6.4±0.5*
SEB – “Jet”	S1-S4	+325.0	+96.1	+104.1	9h 57m 53s	-47.1±2.1
Eq. Cur. (festoons)	E1-E9	+5.5	-223.4	-215.4	9h 50m 38s	102.6±1.1
Eq. Cur. (NEBs blue features)	E10-E14	+8.6	-220.3	-212.3	9h 50m 42s	101.1±0.4
NEB Cur. (barges)	N3-N11	+228.6	-0.3	+7.7	9h 55m 40s	3.6±0.7
NEB Cur. (ovals)	N1, N2, N12	+229.4	+0.5	+8.5	9h 55m 41s	-3.9±1.3
NTC-C	F1-F4	-62.7	-291.6	-283.6	9h 49m 06s	125.1±0.4
NNTC-B	H2	+150.6	-78.3	-70.3	9h 53m 54s	31.0±1*
NNTC	H1, H3, H4	+227.2	-1.7	+6.3	9h 55m 38s	-2.4±1.5
NNNN Temp. Cur.	I3	+221.8	-7.1	+0.9	9h 55m 31s	-0.3±2*
*Estimated uncertainty						

Table 14: Photoelectric Magnitude Measurements of Jupiter Made in Late 2000

Date (2000)	Filter	Mag.	Solar Phase Angle (degrees)	Date (2000)	Filter	Mag.	Solar Phase Angle (degrees)
Sep. 16.29	V	-2.46	11.2	Oct. 27.28	B	-1.76	6.7
Sep. 16.34	B	-1.56	11.2	Nov. 21.16	B	-1.98	1.6
Sep. 16.37	R	-2.92	11.2	Nov. 21.20	V	-2.84	1.6
Sep. 16.41	I	-2.86	11.2	Nov. 21.24	R	-3.32	1.6
Oct. 3.34	B	-1.62	10.1	Nov. 21.28	I	-3.22	1.6
Oct. 3.37	V	-2.57	10.1	Nov. 28.09	V	-2.82	0.2
Oct. 3.40	I	-2.97	10.1	Nov. 28.13	B	-1.95	0.2
Oct. 5.20	R	-3.07	9.8	Nov. 28.18	R	-3.30	0.2
Oct. 27.17	V	-2.74	6.7	Nov. 28.22	I	-3.22	0.2
Oct. 27.20	R	-3.20	6.7	Dec. 8.17	V	-2.80*	2.3
Oct. 27.24	I	-3.09	6.7				

* Mean of 10 measurements; see Figure 6B.

Table 15: Photometric constants of Jupiter measured in 2000

Filter	X(1,0) (normalized magnitude)	c_x (solar phase angle coefficient)
B	-8.51±0.04	0.011±0.007
V	-9.38±0.01	0.005±0.001
R	-9.86±0.02	0.006±0.003
I	-9.77±0.02	0.005±0.003

Feature Story:

The Perception of Asymmetrical Brightness of Saturn's Rings as a Result of Eye Position

By Roger Venable

Abstract

The bicolored aspect of Saturn's rings has been observed often since Walter Haas drew attention to it in 1949. Previous studies have shown that the perception of the relative brightnesses of the ansae of Saturn's rings varies with the position of the optic axis of the eye with respect to the optic axis of the telescope. In the present study, subjects were coached in the observation of the relative brightnesses of the two ansae of Saturn's rings, using equipment and technique designed to differentiate between vignetting and the Stiles-Crawford effect as the eye deviated from the optic axis in directions perpendicular to it. Twelve of the 15 subjects perceived an effect of eye position on the relative brightnesses of the ansae. Of the 29 descriptions by the subjects of their perceptions, six can best be explained by unrecognized vignetting, 12 by the Stiles-Crawford effect, while 11 showed no asymmetry. In every subject in whom vignetting occurred, the asymmetry was slight, and the subject was sure that no vignetting was occurring. In three subjects, the Stiles-Crawford effect was described as dramatic. Applying these results to the classical bicolored aspect, it appears that vignetting may be the cause in some observations, but that the Stiles-Crawford effect accounts for the phenomenon better and completely.

Background

History. Walter Haas noticed in 1949 a bicolored aspect of Saturn's rings that may have been seen earlier by a few other observers. Haas's first published description of it is included here (see side box, "A History of the Bicolored Aspect"). If one reads between the lines, one may note that he considered the effect sufficiently prominent that other observers would likely see it too, if they looked with the recommended violet Wratten 47 filter, and indeed, the observations by Brinckman confirmed this within a month. From his use of the words "strikingly greater brightness" (emphasis his) in his second report of the phenomenon, it is evident that the effect he was describing was not subtle.

An inequality in brightness of the A-ring has been detected in images. It was first reported in 1958 (Camichel, 1958) and is referred to as the "quadripolar azimuthal brightness asymmetry". It is attributed to gravitational scattering of ring particles into wakes in the ring, and it figures prominently into current models of the dynamics of the rings (e.g., Porco, Throop, and Richardson, 2003). Perhaps, with the detection by the Cassini spacecraft of millions of "propeller" structures in the A-ring occurring due to the gravitational effect of tiny moonlets, one could argue that these propellers, seen collectively in perspective, cause the A-ring's azimuthal asymmetry. (These propellers are described and images of them can still be seen on the Cassini spacecraft website. Try *http://www.nasa.gov/mission_pages/cassini/multimedia/pia07792.html*

In any case, this brightness asymmetry is very subtle, and is considered to be undetectable visually. Only in the last couple of years has it been clearly demonstrated in amateur photographs, and that with image enhancement. Haas appears to be describing no such subtle effect. Indeed, he has stated to this author that, since the bicolored aspect makes one whole ansa appear brighter than the other, it must involve at least the B-ring, if not both B and A (personal communication, 2002). Furthermore, the quadripolar azimuthal brightness asymmetry is quadripolar. That is, it involves the dimming of part of the A-ring in the same ansa as the brightening, as well as a symmetrical dimming and brightening in the two quadrants of the A-ring in the other ansa. It is incongruous that it would be considered to be a brightening of one ansa. As of this writing, ALPO Saturn Section Coordinator Julius Benton states that he is unaware of any reports of visual observations that describe a brightness asymmetry with features matching those of the quadripolar azimuthal brightness asymmetry (personal communication, 2006.)

The bicolored aspect of the rings has been noticed at nearly every apparition since 1949. However, it has remained mysterious. One of the mysteries about it is that, though many persons have looked for it, many experienced observers of Saturn say that they have never seen it, and reports of seeing it have been from only a few observers, notably Mr. Haas. For example, in five recent apparition reports published by ALPO Saturn Section Coordinator Julius Benton, there were only 41 positive detections of the bicolored aspect among the many visual reports received. All of these were by four observers: Haas with 31, Crandall with six, del Valle with three, and Benton with one. (Benton, 2000, 2001, 2002, 2003, 2004). The striking visibility of the phenomenon to Haas, together with the difficulty that others have in perceiving it, raises the possibility that its perception is person-specific.

These five recent apparition reports confirm the previously noted relationship of

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Pitfalls In Imaging The Bicolored Aspect

There is a dearth of good images displaying the bicolored aspect. There are a few images that have been promulgated as showing it that, in truth, do not. The best known of these are Charles "Chick" Capen's blue-light photograph (Dobbins, Parker, and Capen, 1988), and two photos, one in red and one in blue light, by Earl Slipher at Lowell Observatory (Dobbins, Heath, and Dikarev, 2003). The feature that disqualifies these three photos is that in each the asymmetry of brightness involves the disc of the planet as well as the rings. There are many things that can cause this, among them several darkroom and film storage foibles. Film woes are passé in this day of CCD's and webcams, but several effects of telescope optics can cause misleading asymmetry in images of Saturn taken with state-of-the-art equipment.

Observers using "planetary Newtonians" often use small diagonal mirrors that vignette all but the center of the field of view. If Saturn is imaged in one of these when it is displaced from the center of the field, it may be vignetted more on one side than the other, so that one ansa is brighter than the other. If such a telescope is out of collimation, Saturn will be vignetted even if it is the center of the field of view.

The coma due to poor collimation, without vignetting, can cause a peculiar appearance that has been mistaken for brightness asymmetry. Here is a drawing made to simulate coma, using the *Aberrator* program written by Cor Berrevoets.

The smearing of light from the right ansa of the bright B ring into the A ring renders the A ring brighter on that side than on the left. Also, the B ring on the left has lost the normal gradation in brightness from its inner to its outer portions, while the same gradation on the right is enhanced. Look for this pattern in your images. Such coma can occur in out-of-collimation SCT's as well as in telescopes of classical design.

The geometry of cameras causes objects in the center of the image area to be brighter than objects in the periphery, because the light striking the periphery is further from the camera lens and is thus spread out more. If Saturn is not centered in the image area, a false brightness asymmetry can be recorded. This effect is unimportant if the imaging is done at prime focus or with a negative projection lenses (Barlow lens), but it is quite important with a positive projection lens (eyepiece projection) or with the afocal technique. Note that the afocal technique is now being widely used with digital cameras.

The irregularities of atmospheric "seeing" can cause transient brightness asymmetry. A published example is an image in Benton (1998), his Figure 8. This image appears as though scintillations have been captured in a noisy background, and it appears to have been so stretched in contrast that its low signal-to-noise ratio causes misleading, excessively bright areas. This can be avoided by ensuring that one's exposure is long enough to yield a high signal-to-noise ratio, or that one's web-cam or video images are stacked with enough frames to give the planet crisp, smooth outlines and low noise. On the same page, Benton reproduces an image (his Figure 9) that also appears to show one ansa brighter than the other. However, this image is so highly stretched in its contrast that one cannot analyze it. Remember that the bicolored aspect is a visual phe-nomenon, sometimes described by Haas as "striking," so you shouldn't need too much stretching to document it!

In summary, imagers wanting to capture the bicolored aspect of Saturn's rings must be certain that their telescopes are well collimated, and that Saturn is in the center of the field of view and in the center of the image area. The image must be of high quality with crisp planet edges and low noise, and it must not be stretched in contrast too far. Best of luck with your imaging!

(Roger Venable)

the phenomenon to the use of filters. Of the 41 detections, allowing for a few that were seen with more than one filter so that the sum is more than 41, there were 38 in violet light, five in red light, and none in integrated light. If one were looking for a phenomenon that could explain these perceptions, one would look for a phenomenon that is quite variable from person to person, and that is most prominent in violet light, intermediately prominent in red light, and barely evident in integrated or green light.

One of the puzzling features of the bicolored aspect is the difficulty observers have had in imaging it. Most attempts have simply failed, and some serendipitously asymmetrical images have been misleading (see side box, “Pitfalls in Imaging the Bicolored Aspect”). It remains, primarily, a visual phenomenon.

The effect has been attributed to vignetting (Haas, personal communication, 1997). When one uses a Wratten 47 filter at high magnification, the background sky appears so dark that the edge of the field of view is not visible. Since one uses the visibility of the edge of the field of view to guide the positioning of the eye, the eye can then drift away from the optic axis of the telescope without the observer's awareness of the drift.

During the 1993-94 apparition, the author found that he frequently saw the bicolored aspect, and began to study its visibility. He discovered first that some observing companions saw the brightening on the ansa opposite from his own perception, and he then discovered that he could make the effect switch from ansa to ansa by moving his head from side to side in the directions of the ansae. Further investigation with various magnifications and filters confirmed that the effect he was seeing was the Stiles-Crawford effect (Venable, 1998). Upon publishing that information, he was surprised that no other observers reported to him that they could confirm it. Like Walter Haas, he had found a phenomenon that was obvious to him but that few other persons could perceive. Were he and Haas seeing the same phenomenon? A follow-up study by the author involved 12 subjects who were coached by the author while observing Saturn at high magnification with a Wratten 47 (violet) filter. Nine of the subjects found that moving the head (and thus the eye) laterally along the direction of the ansae resulted in an asymmetry in the perceived brightness of Saturn's rings. Six of them found the effect to occur with both motion to the right and to the left, and all of these six found that the effect changed to the opposite ansa when the head was moved in the opposite direction. The study was carried out over three nights, and it included multiple simultaneous detections of the phenomenon, some in agreement and some in disagreement with one another with regard to which ansa appeared brighter. These results were presented at the 2002 ALPO convention in Frederick, Maryland, and they have not been published in print. A limitation of the study is that the experimental technique did not allow the experimenter to differentiate between vignetting and the Stiles-Crawford effect as the cause of each subject's perceptions.

Understanding vignetting and the Stiles-Crawford effect. To understand vignetting as it is studied here, one must first understand what an exit pupil is. Although the term is sometimes used in other ways, the author uses it as described in Figure 1 — it is the virtual disc centered on and perpendicular to the optic axis in which the parallel rays from every part of the eye-

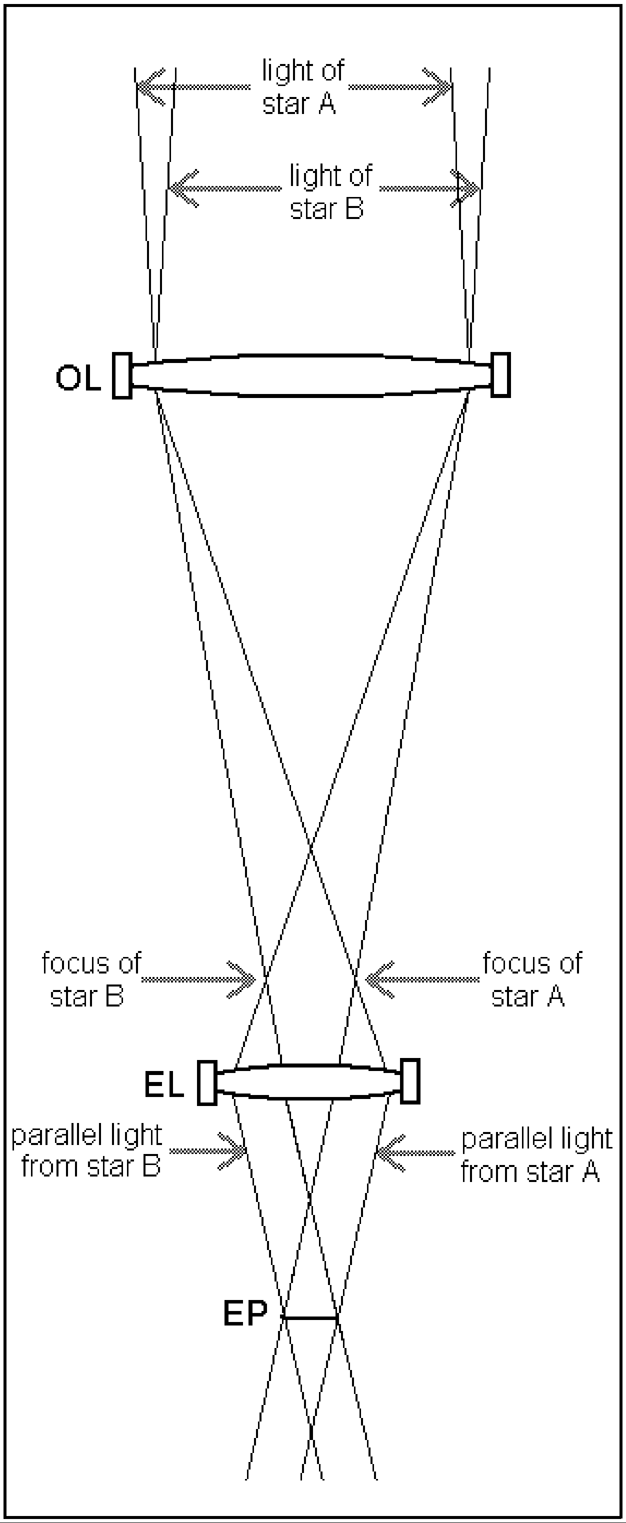

Figure 1. The objective lens (OL in the diagram) captures light from a small area of sky and brings it to a focus that is located in a slightly different point for each star in the field. Beyond the focal point the light from each star spreads out, so that the eyepiece receives it over a small area of the eyepiece lens (EL), not at just a single point. The eyepiece bends this light so that the light from each star leaves the eyepiece parallel. The eye can focus rays on its retina only if they are nearly parallel when they enter the eye. The light rays from different stars leave the eyepiece at different areas of the lens. These rays, though parallel for each area of the field of view, cross in a small area behind the eyepiece. The crossing area is a virtual disc called the exit pupil (EP) that floats behind the eyepiece. The plane of the exit pupil is perpendicular to the optic axis so that we see it edge-on in this drawing.

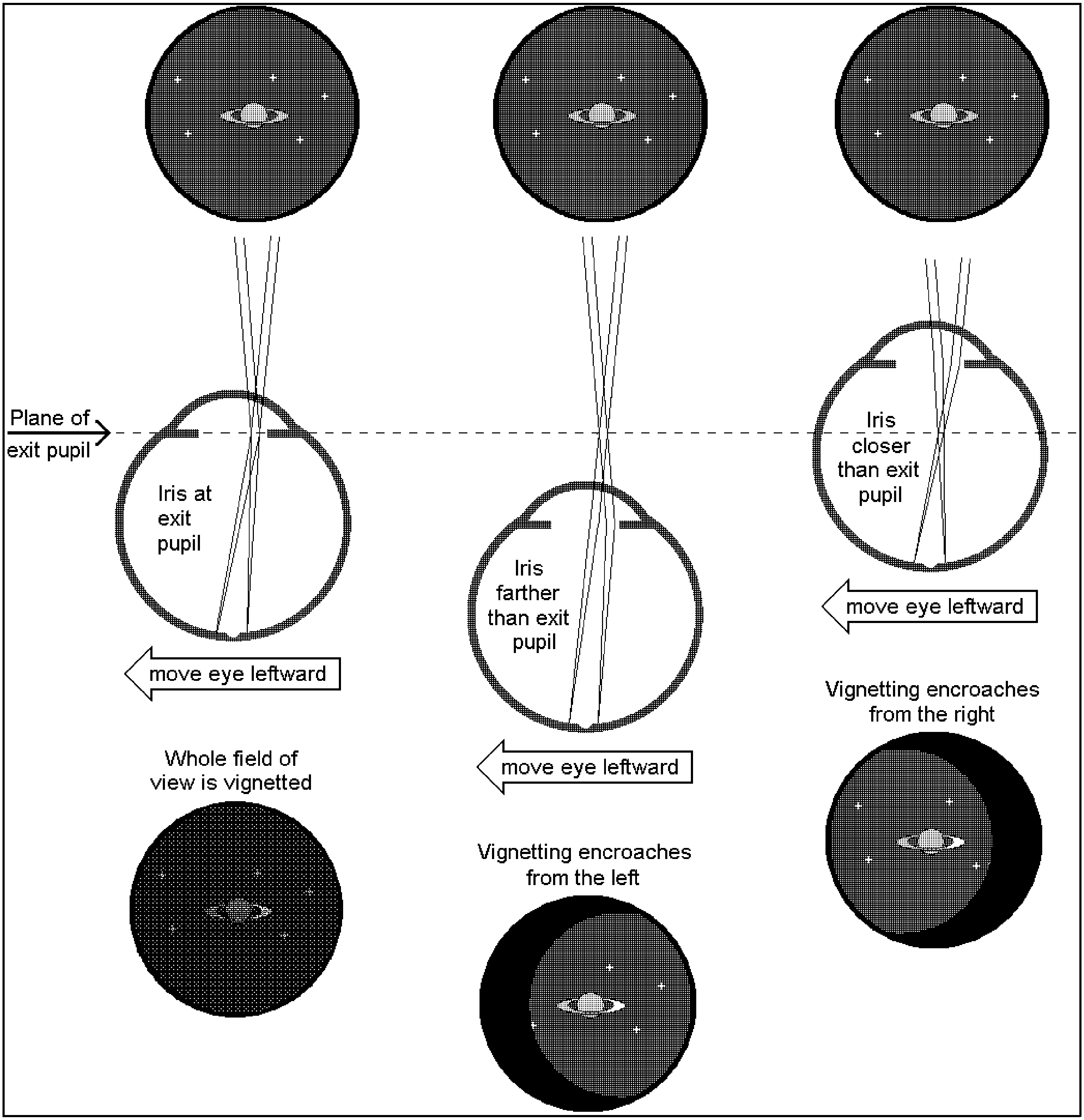

Figure 2. Three types of vignetting are shown. The type of vignetting depends on where the iris is in relation to the plane of the exit pupil. The Stiles-Crawford effect is also shown. In contrast to vignetting, the Stiles-Crawford effect always causes the right ansa to appear brighter than the left when the eye is moved leftward.

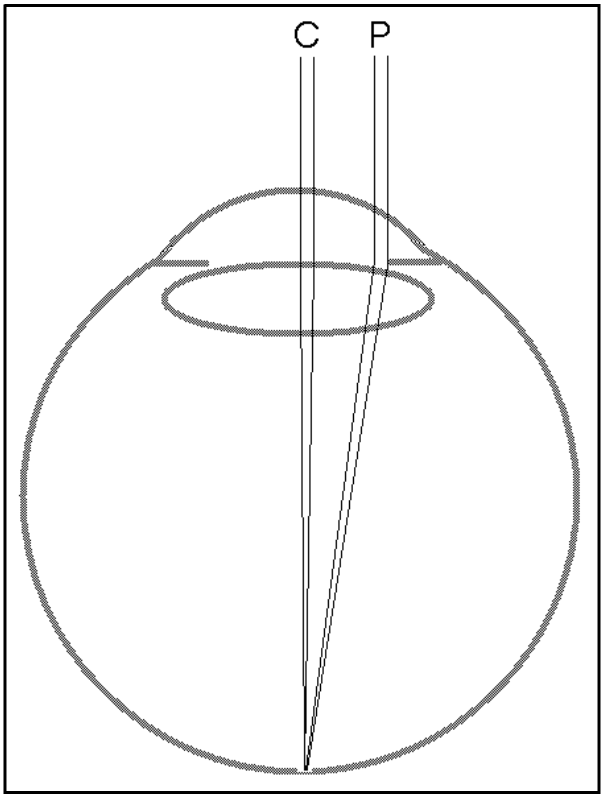

Figure 3. In the Stiles-Crawford effect as it was first described, a narrow beam of light passing to the fovea area through the center of the pupil (C) is perceived as brighter than the same beam passing to the fovea through the periphery of the pupil (P). Stated another way, rays that strike the retina perpendicular to it are seen as brighter than oblique rays.

piece lens cross. When the observer's iris is at the exit pupil, he can see the entire field of view without vignetting (provided that the exit pupil diameter is smaller than the eye's pupil diameter.) When his eye's pupil moves away from the exit pupil, part of the field of view becomes invisible to him because the iris blocks the light from that area. This is vignetting as it is studied here.

When the observer's iris is at the exit pupil and his head moves leftward, his iris obstructs light from the entire field of view so that the entire field darkens simultaneously (left diagram of Figure 2.) In contrast, when his iris is further from the eyepiece than the exit pupil is, the first rays that his iris obstructs as his head moves leftward are those from the left side of the field of view, and a black crescent of vignetting encroaches on the field from the left (middle diagram of Figure 2.) Lastly, when his iris is between the eyepiece and the exit pupil, the first rays that his iris blocks as his head moves leftward are from the right side of the field of view, so that the crescent of vignetting encroaches from the right (right diagram of Figure 2.) Thus, the observer can tell where his iris is in relation to the exit pupil by the type of vignetting that he observes.

The Stiles-Crawford effect was first described by its namesake researchers in 1933 (Stiles and Crawford, 1933). Light that strikes the retina perpendicularly is perceived as brighter than the same light that strikes the retina obliquely, as diagrammed in Figure 3. The effect is color-dependent, being most prominent in violet, intermediately prominent in red, and least evident in green. It is an effect of cones, not rods (Flamant and Stiles, 1948), and as such, it is known to affect the cone-dense area near one's central vision. As applied to Saturn, the visibility of the effect depends on exit pupil size and on magnification. A small exit pupil allows all the light from the planet to enter the eye's pupil in a narrow beam that, if it is displaced to one edge of the eye's pupil, will cause the light from one ansa to strike the retina more obliquely than the light from the other ansa does (Figure 4). Increasing the magnification increases the distance between the retinal projections of the two ansae, and so increases the obliquity of the incidence of the light from the east ansa in Figure 4.

The Stiles-Crawford effect results in a perception of brightening of the right side of Saturn when the eye moves leftward regardless of the distance of the eye from the eyepiece. This is in contrast to vignetting, in which the distance of the eye from the eyepiece makes a difference, as described above. The Stiles-Crawford effect is portrayed in Figure 2 by the brightening of the right ansa of Saturn in all three diagrams at the bottom.

Rationale for the present study. Notice that, when the eye is between the eye lens and the exit pupil, the Stiles-Crawford effect and vignetting have opposite effects

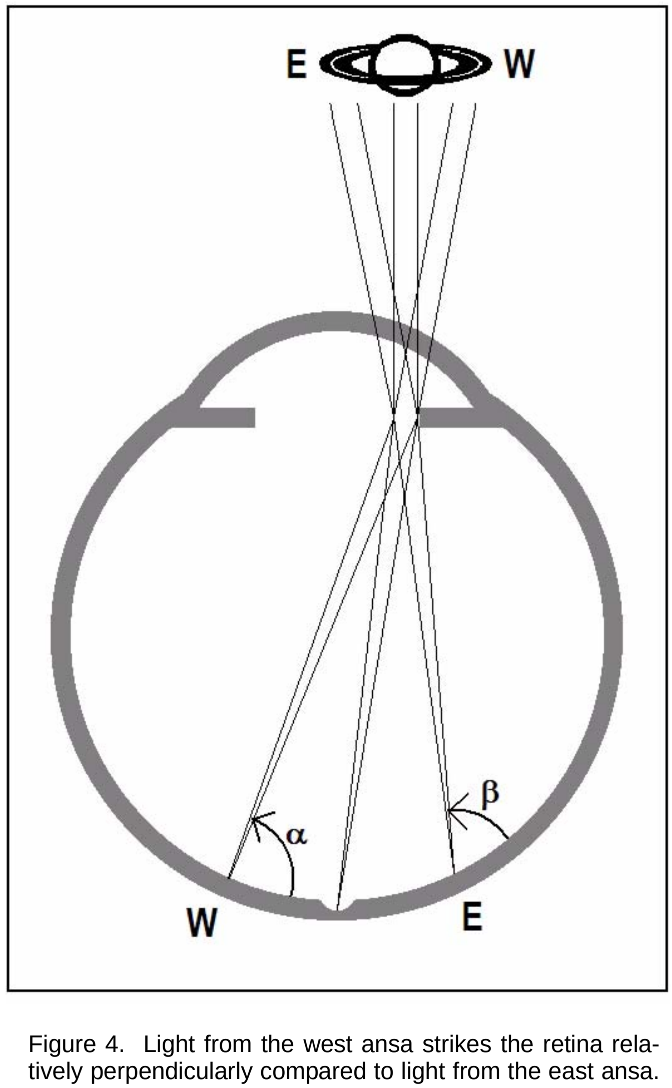

Figure 4. Light from the west ansa strikes the retina relatively perpendicularly compared to light from the east ansa. That is, angle a is greater than angle b. The west ansa will be perceived as brighter than the east ansa due to the Stiles-Crawford effect. Depicted is a 7-mm iris pupil and a 1-mm exit pupil. The size of Saturn's image on the retina is greatly exaggerated for clarity.

on the perceived relative brightnesses of the ansae (Figure 2, right diagram). An eyepiece that has a long distance between the eye lens and the exit pupil, that is, a long “eye relief”, will allow subjects to reliably position their eyes between the eye lens and the exit pupil. The positions of their irises can be confirmed by the directions from which vignetting is seen to encroach upon the visual field when their heads are moved laterally. Their observations of which ansa became brighter will enable the experimenter to ascertain the relative importance of vignetting versus the Stiles-Crawford effect in causing the brightness asymmetry. Observers will require coaching during such observations. Equipment using high magnification and a Wratten 47 filter will duplicate the conditions under which the bicolored aspect has been seen the most. This study is designed to be qualitative and semi-quantitative, so that a large number of subjects is not needed.

Equipment and methods

The equipment and its use. All the observations were made with a Celestron brand Schmidt-Cassegrain telescope of 280-mm (11-in.) aperture and f/10 optics, equatorially mounted and clock-driven. The eyepiece had a focal length of 8-mm. The combination of the objective lens and eyepiece yielded a nominal magnification of 350x and an exit pupil size of 0.8-mm.

The eyepiece was of the Radian type, made by TeleVue, with 20-mm eye relief. This is unusually large eye relief, and it was used with the eye guard fully retracted so that the observer's eye could be situated very close to the eye lens. Thus, subjects (with one exception) were able to keep their irises between the eye lens and the exit pupil, as represented in the rightmost diagram in Figure 2. In this regard, the direction from which vignetting encroached as the eye was moved laterally was used as confirmation of iris position during the observations.

Dewing was prevented by a dew shield. The orientation of Saturn as seen in the eyepiece was made horizontal by rotation of the star diagonal at its attachment to the optical tube assembly. Subjects were seated on an observing chair with adjustable height. Before each subject began the observation, the author checked the corrector plate for dewing, rotated the star diagonal as needed, centered Saturn in the field of view, refocused for fully corrected vision, and adjusted the chair location and height for the subject's comfortable viewing. Subjects were allowed to adjust the focus for the sharpest view.

A glass Wratten 47 filter (violet) that screwed into the eyepiece stem was used for all observations. At the high magnification used, this filter caused the light from the background sky around Saturn to be imperceptible, so that the edge of the field of view could not be seen. Therefore, vignetting could not be perceived except insofar as it encroached upon the image of the planet itself, not in the background field of view.

All the subjects were participants in the 2006 Winter Star Party in the Florida Keys (USA), and the observations were made at latitude of +24° 38'.90 and longitude of -81° 18'.62 during that event.

The averted vision effect. After confirmation that the subject had a good view of the planet, the averted vision effect was explained to the subject. For many observers, when Saturn is viewed at high magnification with a filter and the observer

Table 1:

#	Date	Age	Sex	Med	Exp	See	Tr	Alt	AV	L Interp	R Interp
1	2/23	50	F		2	8	E	65	2	Mod SC	Mod SC
2	2/23	60	M	M	3	8	E	71	0		No
3	2/23	54	M	M	3	8	E	74	2	No	No
4	2/24	40	M		3	9	E	78	2	No	Mod SC
5	2/24	54	M		2	9	E	83	2	No	Sl V
6	2/24	57	M	M	3	9	E	77	1	Sl V	Sl V
7	2/24	54	M		2	9	E	64	2	Sl V	Sl SC
8	2/24	49	M	M	3	9	E	60	3	Dr SC	Sl SC
9	2/24	46	M		2	9	E	33	3	Sl SC	No
10	2/24	63	M	H	2	9	E	28	1	Sl V	Sl SC
11	2/25	67	M	F	2	7	G	63	1	Sl SC	Sl V
12	2/25	36	M	M	2	7	G	67	1	No	Dr SC
13	2/25	58	M	MR	3	7	F	85	0	Sl SC	No
14	2/25	65	M	MA	3	7	F	80	2	No	No
15	2/25	69	M	MA	2	7	G	78	2	Dr SC	No

Key: Age is in years. Sex is F for female and M for male. Med is medical eye conditions, with M myopia, H hyperopia, F floaters, R retinal lesion, and A astigmatism. Exp is self-rated experience level, with 3 extensive, 2 moderate, 1 slight, and 0 none. See is seeing on the ALPO scale, with 1 very poor and 10 perfect. Tr is transparency, with E excellent, G good, and F fair. Alt is the sky altitude of Saturn in degrees. AV is the subject’s rating of the strength of the averted vision effect, with 0 none, 1 subtle, 2 medium, and 3 dramatic. L Interp is interpretation of subject’s perception of the relative brightnesses of the ring ansae when head moved leftward, with No meaning no perceived asymmetry, Sl meaning slight, Mod moderate, and Dr dramatic, and with SC meaning Stiles-Crawford effect, and V vignetting. R Interp is the same as L Interp but for head motion to the right.

A History of the Bicolored Aspect

Asymmetry in the colors of the ansae of Saturn's rings was noted long before the ALPO began to monitor it. Perhaps the first notice of it was made by William Lassell, who, observing in steady seeing on December 28, 1852, with his 48-inch reflector in Malta, wrote:

> "I compared under these advantageous circumstances the two ends of the obscure ring [i.e., C – ed.]. . . . I noticed a difference in the colour, the preceding end being bluish-grey, while the following had a touch of yellow or brown in its greyness" (Lassell, 1852).

Lassell was in continual contact with W. R. Dawes, who was the next person to write of such a finding in the C ring. On December 12, 1854, he noted that the following ansa was "ruddier" than the preceding, but on January 16, 1855, he noted a reversed appearance, with the preceding ansa "ruddy" and the following "slate colored" (Dawes, 1855.) Then on November 27, 1855, Lassell noted that "the preceding arm of C was brown and the following grey" (Lassell, 1856). Finally, on December 20, 1855, Dawes noted "differences in tint of different portions" of C, but did not give details (Dawes, 1856). Neither observer noticed color asymmetry in any ring except C. For a number of years in the mid-nineteenth century, each published a number of other descriptions of the rings without any mention of a color asymmetry.

James Bartlett may have been the first to use the term, "bicolored aspect," in describing the observations he made in the early 1940's. In contrast to Lassell and Dawes, he saw asymmetry in the colors of only the A ring. He noted that ring's two ansae to occasionally appear bluish versus reddish. After several years of occasionally recording the effect, he concluded in 1945 that it was an illusion. It was on January 24, 1945, that he first found the colors to shift from side to side, reversing as he watched. He noted that a change of eyepiece, or of focus, or even "staring at the ring steadily for a few minutes," would cause the colors to shift. His conclusion that the effect "depends upon the state of the eye" is similar to the thrust of the present paper, as is his proposal that it ". . . is a worthy puzzle for those who like to delve into the mysteries of optics. . . ." He was unable to specify a mechanism by which the effect would occur (Bartlett, 1945).

In the early days of *The Strolling Astronomer*, our journal was written by Walter Haas and others, and it consisted mostly of a well-organized narrative about interesting recent observations by Haas and his correspondents. In late 1949 he wrote:

> "On November 14, 17, and 20 the editor was surprised to find a difference in the brightness of the east and west arms of the rings with some color-filters but not with others. He would prefer to give no more details here but to ask observers to compare the brightness of the two arms with filters ranging from dark red to dark blue" (Haas, 1949)."

Thus, Haas appears to be the first to use filters to help reveal this color difference. Insofar as he noted one whole ansa to be brighter than the other, it is not clear that he was seeing the same phenomenon witnessed by Lassell, Dawes, and Bartlett. In the next issue, he wrote:

> ". . . Haas made 18 comparisons of the relative brightness of the east and west arms of the rings on 15 different dates. On every single occasion the west arm . . . was the brighter of the two with Wratten Filter 47 (blue). No difference was ever seen without a filter or with Wratten Filter 58 (green). With Wratten Filter 25 (red) the west arm occasionally looked brighter, but usually there was no difference. While visiting Haas, Brinckman on November 28 independently "discovered" a <u>strikingly</u> greater brightness of the west arm with Filter 47 and confirmed the lack of a difference with Filters 25 and 58 or no filter. He repeated these results on November 30 and December 2. . . . The relative brightening of the west arm with this filter is probably by no means always equally great, and on November 30 the two observers independently found the difference in brightness less at 12h 41m than at 9h 34m. . ."(Haas, 1950).

Thus, within 16 days of his first detection of it, Haas characterized the phenomenon according to the filters that revealed it, and its inconstancy. In that issue, Haas went on to say:

> "What is the cause of this strange appearance? It may have been a very new development on November 14, for Haas saw nothing of it in examinations of Saturn with color filters last autumn . . . . The same reasoning would indicate that this phenomenon was surely absent in recent past apparitions, and the editor can recall no references to it in astronomical literature. Why would the west arm of the rings reflect more light than the east arm in blue and about the same amount in other colors?"

His question is still open for discussion. I hope that the present article sheds some unfiltered light on it.
-- Roger Venable.

gazes fixedly at one ansa, the other ansa will be perceived by averted vision to be brighter. By switching his gaze back and forth between the two ansae, the observer can switch which ansa appears brighter. This effect interferes with the perception of the bicolored aspect. The averted vision effect varies from person to person, and it is not always symmetrical. Therefore, each subject was first asked to familiarize himself with the effect by looking at the ansae and noticing the brightness of the opposite side by averted vision. Then, each subject rated the strength of this illusion on a scale of 0 = none, 1 = slight, 2 = moderate, and 3 = dramatic. Lastly, each subject was asked to ascertain the point along the horizontal axis of Saturn at which he could gaze to render the two ansae of equal apparent brightness. This was referred to as his "neutral point" and he was asked to remember where it was.

For many observers, when Saturn is viewed at high magnification with a filter and the observer gazes fixedly at one ansa, the other ansa will be perceived by averted vision to be brighter. By switching his gaze back and forth between the two ansae, the observer can switch which ansa appears brighter. This effect interferes with the perception of the bicolored aspect.

The positioning of the eye. Each subject was told that the experiment involved the perception of a difference in the brightnesses of the two ansae associated with slight changes in eye position. Subjects were advised to touch their brows to the eyepiece, and use a finger to span the distance between the brow and the eyepiece so as to give fine guidance to the motion of the head. The subject was directed to move his head (and thus to move his eye with respect to its alignment with the optical axis of the telescope) to the left very slowly and observe the vignetting that encroached on the view of the planet. If the subject's iris is between the exit pupil and the eye lens, vignetting will encroach from the right when the head is moved to the left. In a few cases in which the subject observed the vignetting encroaching from the left, his head position was adjusted, usually by himself but once by manual positioning of it by the author, so as to allow him to move his eye closer to the eyepiece, followed by confirmation that the vignetting now encroached from the right. The subjects were instructed to stop the lateral motion of their heads in a position that was just short of the point where vignetting began to encroach on the planet. They were to be sure that there was no vignetting, and also that the eye was moved as far to the left as possible without incurring vignetting. Each subject performed this maneuver, with coaching when needed, until he was confident that he was doing it as requested.

The key observation. With the eye positioned as described above, the subject stared directly at his neutral point. After a delay of four seconds, so as to allow the Stiles-Crawford effect time to manifest itself, he was to notice (with averted vision while looking at his neutral point) whether one ansa appeared brighter than the other. If he perceived a difference, he was asked to state which ansa was brighter and to rate the prominence of the asymmetry on a scale of 1 = slight, 2 = moderate, and 3 = dramatic.

Upon completion of the leftward observation, the head was moved to the right and the homologous observation was made on that side.

Results

The data are presented in Table 1, with the Key to the table located below it. One can see from the table that most of the subjects were myopic, middle-aged men with plenty of experience in observing Saturn. These characteristics probably reveal more about the population participating in the 2006 Winter Star Party than they do about the bicolored aspect. Observing conditions were quite good, in that seeing and transparency were better than average and for most of the observations Saturn was high in the sky.

Subject number 2 was able to make vignetting encroach from the left when he moved his head rightward, but he was unable to make vignetting encroach from the right when he moved his head leftward. Therefore, no datum is recorded for his head-leftward attempt.

Of the 29 data recorded, it is striking that 18 of them describe a perception of asymmetry due to eye position, and that some brightness asymmetry was seen by 12 of the 15 observers. It is also noteworthy that there is a wide range in the visibility of the brightness asymmetry, ranging from none to dramatic, from person to person. The perception of a brightness inequality has no correlation demonstrable in the data with respect to age, ocular medical conditions, experience, observing conditions, Saturn's altitude, or the subject's perception of the averted vision effect.

In all six cases in which vignetting explains the subject's perception, the effect was described by the subject as slight. In contrast, the prominence of the Stiles-Crawford effect was described as dramatic in three instances, moderate in three, while in six cases it was slight.

Another salient feature of these results is that each of subjects 1, 6, and 8 detected with head motion to the left a relative brightening of the ansa opposite to that detected with head motion to the right. Subjects 1 and 8 witnessed the Stiles-Crawford effect, while subject 6 experienced vignetting. This switching of the bright ansa is incompatible with a planetologic effect, and it is strongly confirmatory that both effects arise within the eye and optics. Further negation of the planetologic origin of the asymmetry is that on 2/24 and 2/25 there were a number of disagreements between observers about which ansa was brighter.

By the reports of the subjects, their neutral points were usually not in the exact center of Saturn's globe.

Discussion

Like the study that the author presented at the 2002 ALPO convention, the present study shows that the off-center position of the eye at the eyepiece causes an inequality in the perceived brightness of the two ansae of Saturn's rings in the majority of subjects: 12 of 15 subjects in this study, and nine of 12 in the previous one. These studies both duplicated conditions under which the bicolored aspect has been most observed, namely, high magnification and the use of a Wratten 47 filter. The inability of observers to see the edge of the field of view under these conditions, so that the eye can wander from the optic axis without the observer being aware of it, makes this wandering a particularly good candidate to explain the classical bicolored aspect.

Every subject in the present study whose perception is consistent with unrecognized vignetting (six observations among five of the 15 subjects) was confident that he was not causing vignetting when he made his observation. This is relevant to any observer who has seen the bicolored aspect of Saturn's rings and who is certain that he was not vignetting the field of view when he saw it. Vignetting can occur so subtly that even these subjects, who were experienced Saturn observers, were unable to detect it. Thus, unrecognized vignetting is a candidate explanation of the classical bicolored aspect.

Although in this study the effect of unrecognized vignetting was always described as slight, the Stiles-Crawford effect was described as slight only half the time when it was detected. Three times it was seen as moderate, and three times as dramatic. It was seen by twice as many subjects as vignetting was (10 versus 5) and in twice as many of the 29 descriptions (12 versus six). This greater visibility suggests that it might be described as “striking” by some observers, like the bicolored aspect has been described. By that reason alone it would be a better candidate than vignetting is to account for the classical bicolored aspect. Moreover, its candidacy is bolstered greatly by the fact that, like the bicolored aspect, it is best seen in violet light, next-best seen in red light, and least well seen in green or integrated light. These characteristics make it the probable cause of 57 years of detections of the bicolored aspect of Saturn's rings.

Indeed, in the face of this evidence, it is inappropriate to continue to report the bicolored aspect as though it were a planetary feature. The challenge is no longer to show that eye position accounts for the bicolored aspect. The burden of proof is on those who consider it to be a planetary feature, to show that it still merits reporting. Much more useful are reports of the quadripolar azimuthal brightness asymmetry of the A-ring, especially if it is measured by using a CCD camera or photometer.

Readers may ascertain how their own perceptions respond to moving the eye away from the optic axis by carefully following the observing procedure outlined in this article. It is wise to make note of the averted vision effect, for this was a confounder to two false starts to this study. (The procedure as it was conducted on the present subjects accommodated the averted vision effect, and this is a strength of the study.) Readers who try this should not be disappointed if they cannot see it, since three of the 15 subjects in this study could see no effect.

It is natural to attempt to see these eye-position effects on celestial objects other than Saturn. However, the shape of Saturn is ideal for the manifestation of these effects. When the rings are near edge-on, it is harder to see. The author has seen it on Jupiter but with much more difficulty. He has also seen it on the defocused images of bright stars. Extended deep sky objects are seen mostly with retinal rods and are too faint to demonstrate the effect.

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Will, M. .... will008@attglobal.net

Online Readers

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 and your own e-mail program will open with a blank e-mail preaddressed to the person you chose. NOTE: Your Internet connection MUST be ON for this feature to work.

ALPO Resources

People, publications, etc., to help our members

many solar references. Produced by ALPO Solar Section Assistant Cordinator and Arhivist Jamey Jenkins, this publication replaces *Observe and Understand the Sun* and its predecessor, *The Association of Lunar& Planetary Observer's Solar Section Handbook for the White Light Observation of Solar Phenomena*, both by the ALPO's own Rik Hill. To order, send check or US money order made payable to Jamey Jenkins, 308 West First Street, Homer, Illinois 61849; e-mail to *jenkinsjl@yahoo.com*

- **Lunar and Planetary Training Program:** *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. Send check or money order payable to Timothy J. Robertson, 2010 Hillgate Way #L, Simi Valley, CA 93065.

- **Lunar (Benton):** (1) *The ALPO Lunar Section's 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://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/selarea.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://www.zone-vx.com/tlo.pdf* or 70 cents per copy hard copy; send SASE with payment (check or money order) to: William Dembowski, Elton Moonshine Observatory, 219 Old Bedford Pike, Windber, PA 15963

- **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):** (1) *ALPO Venus Observing Kit,* $17.50; includes introductory description of ALPO Venus observing programs for beginners, a full set of observing forms, and a copy of *The Venus Handbook.* (2) *Observing Forms,* free at *http://www.lpl.arizona.edu/~rhill/alpo/venustuff/venusfrms.html* or $10 for a packet of forms by regular mail (specify *Venus Forms).* To order either numbers (1) or (2), send a check or money order payable to "Julius L. Benton, Jr." All foreign orders should include $5 additional for postage and handling; p/h included in price for domestic orders. Shipment will be made in two to three weeks under normal circumstances. 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, c/o Marion M. Bachtell, P.O. Box 572, West Burlington, IA 52655; FAX: 1-319-758-7311; e-mail at alsales@astronomicalleague.com. *(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").

- **Jupiter:** *(1) Jupiter Observer’s Handbook*, $15 from the Astronomical League Sales, c/o Marion M. Bachtell, P.O. Box 572, West Burlington, IA 52655; FAX: 1-319-758-7311; e-mail at alsales@astronomicalleague.com. (2) *Jupite*r, the ALPO section newsletter, available onlineonly via the ALPO website; (3) *J-Ne*t, the ALPO Jupiter Section e-mail network; send an e-mail message to Craig MacDougal. (4) *Timing the Eclipses of Jupiter’s Galilean Satellites* observing kit and report form; send SASE to John Westfall. (5) *Jupiter Observer’s Startup Ki*t, $3 from the Richard Schmude, Jupiter Section coordinator.

- **Saturn (Benton):** (1) *ALPO Saturn Observing Ki*t, $20; includes introductory description of Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handboo*k. Newly released book *Saturn and How to Observe It* (by J. Benton) replaces to *The Saturn Handbook* in early 2006. (2) *Saturn Observing Forms*, free at *http:www.lpl.arizona.edu/~rhill/alpo/satstuff/satfrms.html* or $10 by regular mail. Specify *Saturn 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 Saturn section.

- **Meteors:** (1) *The ALPO Guide to Watching Meteors* (pamphlet). $4 per copy (includes postage & handling); send check or money order to Astronomical League Sales, c/o Marion M.

ALPO Resources

People, publications, etc., to help our members

Bachtell, P.O. Box 572, West Burlington, IA 52655; FAX: 1-319-758-7311; e-mail at alsales@astronomicalleague.com. (2) *The ALPO Meteors Section Newsletter*, free (except postage), published quarterly (March, June, September, and December). Send check or money order for first class postage to cover desired number of issues to Robert D. Lunsford, 1828 Cobblecreek St., Chula Vista, CA 91913-3917.

- **Minor Planets (Derald D. Nye):** *The Minor Planet Bulletin*. Published quarterly; free at *http://www.minorplanetobserver.com/mpb/default.htm* or $14 per year via regular mail in the U.S., Mexico and Canada, $19 per year elsewhere (air mail only). Send check or money order payable to "Minor Planet Bulletin" to Derald D. Nye, 10385 East Observatory Dr., Corona de Tucson, AZ 8564I-2309.

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 witrh 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 (JALPO)***. Many of the back issues listed below are almost out of stock, and it is impossible to guarantee that they will remain available. Issues will be sold on a first-come, first-served basis. The price is $4 for each back issue; the current issue, the last one published, is $5. We are always glad to be able to furnish old issues to interested persons and 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," on page 59):

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THE ASSOCIATION OF LUNAR & PLANETARY OBSERVERS (ALPO)

The Association of Lunar and 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. 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 Journal at appropriate intervals. Each 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 through our web site via e-mail or at their postal mail addresses listed in back of our Journal. Out web site is hosted by the Lunar and Planetary Laboratory of the University of Arizona which you are encouraged to visit at http://www.lpl.arizona.edu/alpo/. 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. Membership dues include a subscription to the Journal. The ALPO offers a printed version of the Journal that is mailed out quarterly. An identical digital (portable document file, or pdf) version is available over the internet at reduced cost.

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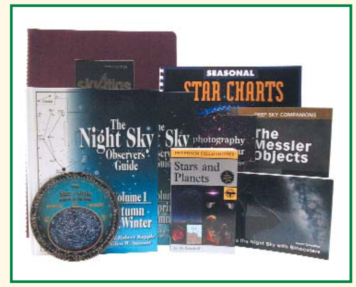
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