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The Strolling Astronomer

Volume 47, Number 4, Autumn 2005
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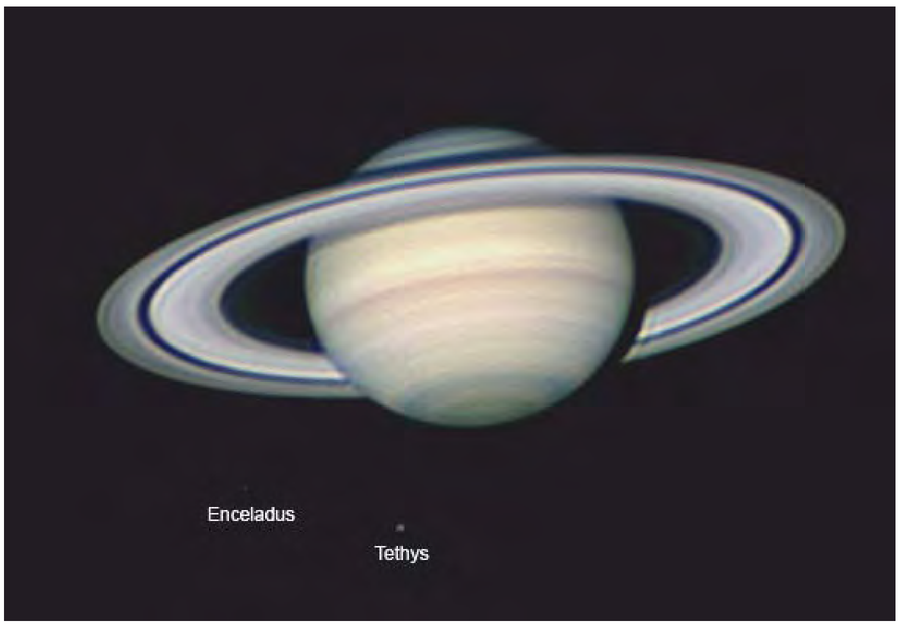
Inside. . .

- ***The fine art – and very fine work – of timing the Galilean satellites***
- ***Book review: Clementine Atlas of the Moon***
- ***Apparition reports on Mercury and Venus***



Saturn is back — and he's an all-nighter! See details about this superb image by Christopher Go on page 44.

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

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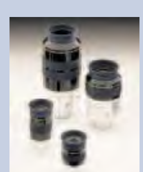

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Journal of the Association of Lunar & Planetary Observers,

The Strolling Astronomer

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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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Point of View
ALPO – Just What I Needed!!

By Lynn M. Laux, ALPO member!

When I was a little girl sitting on the front porch looking up at the stars and trying to match the patterns in the sky to those in H.A. Rey's book "Know the Stars", I never thought I would get so involved in amateur astronomy as to desire to contribute to the science of what I was looking at. Yet here I am.

My journey started over 12 years ago when I found an orange tube Celestron 8 stashed away in the physics "junk" closet of the high school where I was teaching. No one seemed to know what it was! Later, I found the wedge, eyepieces, and filters that went along with the scope stored in a box labeled "Michaelson Interferometer." I took the telescope to a local astronomy club, where I found out that the previous user had stored the scope in such a condition that mold had grown on the corrector and rubber gaskets — rendering it almost useless. On the advice of experienced club members, I sold the scope to

Continued on page 16.

Inside the ALPO
Member, section and activity news (continued)

News of General Interest

New Solar Section Coordinator

From: Julius Benton, Executive Director, Assn of Lunar & Planetary Observers

I am delighted to advise everyone that our colleague, Ms. Kim Hay, has accepted the appointment to Acting Coordinator of the ALPO Solar Section. Please join me in congratulating Kim on her expanded duties, and I must say that her contributions are certainly appreciated.

I'm sure that we all wish Kim the best as she begins her duties in this important role. And I am sure that all of us on the Board will be willing to offer assistance, guidance, and suggestions as needed.

And of course, we welcome the input of all members on how we can all work together to make the ALPO a better organization for all.

Errata

From: Harry Jamieson

Dear Readers,

It has come to my attention that I did not list Jim Phillips as a contributor to the work of the Lunar Dome Survey in our 1992 paper "Lunar Dome Catalog" (JALPO Vol. 36 No.3, pp 123-129).

This embarrassing oversight was entirely my fault, and I apologize for it.

The truth is that Dr. Phillips devoted several years of his time — plus a great deal of effort and money — to the program in an effort to clean up the ALPO's dome catalog (a work still in progress!).

The ALPO owes Jim a great debt of gratitude for his many years of fine service as well as for his many financial contributions, and I am only sorry that I did not learn of my omission to list him until now.

Our Advertisers

Folks!! We give a hearty welcome to two new advertisers in the Journal of the Assn. of Lunar & Planetary Observers. Anacortes Telescope & Wild Bird of Anacortes, Washington, and Scope City — names that many of our readers are familiar with.

We also thank Sky Publishing for its continued support and Accurate Graphics for its consistently top-notch handling of this Journal.

We urge our readers to contact our advertisers as you make plans to either add to your book or magazine collection, purchase scopes or equipment or even seek professional printing services.

Dues Change

This is your reminder, folks. Faced with rising postal and production costs for this Journal, the ALPO board of directors voted at its 2005 meeting to adjust the ALPO dues structure accordingly.

This dues adjustment is detailed in the board of directors article in this issue of your Journal.

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.

Inside the ALPO
Member, section and activity news *(continued)*

Yes, This IS the Autumn JALPO

Well, at least I'm catching up.

ALPO Resources Updates

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 2006 Conference Set for Atlanta

The 2006 conference of the Association of Lunar & Planetary Observers will be held Thursday, Friday, Saturday, July 20, 21 and 22, in Atlanta, Georgia, specifically at the Fernbank Science Center, with out-of-towner lodging being arranged at nearby Emory University; a banquet on Saturday evening will feature a special keynote speaker. Attendees also have the option to arrange for their own lodging elsewhere.

This event is open to ALL. At this time the pre-registration fee is expected to be around $30, with the walk-in fee higher. Also, the final registration fees are subject to change as all event costs are ascertained; the Emory University lodging fees are expected to be somewhere near $30 per person.

While the primary purpose of our annual conference is for the presentation of papers and other data on solar system astronomy by a number of ALPO members, a special bonus this year will be a special lunar & planetary imaging demonstration.

The demo will be led by ALPO member Larry Owens, whose expertise in imaging is arguably at or near the top. For a sample of his work, set your browser to *http://www.atlantaastronomy.org/CEWMA/larry_owens_images.html*

The ALPO conference lunar & planetary imaging demo will feature the use of the Registax 3.0 for stacking and preliminary processing of webcam-acquired images, along with post-processing techniques to use in your own graphics program (Adobe *PhotoShop*, Corel *PhotoPaint*, etc.). For those who wish to get a head start now, Registax is available for free at *http://registax.astronomy.net/*

The objects of study will include the Moon (between Last Quarter and New Moon at that time), as well as those planets up for nighttime viewing in mid-late July; this includes Venus, Mars, Jupiter, Neptune, Uranus and Pluto. A pdf version of Mr. Owens' presentation will be made available for free to all who attend this demo; while a number of tutorials is available everywhere online, the presence of other individuals who can assist with questions then and there at the conference is a major advantage to this demo versus working through things on your own.

All members of our fine organization are urged to consider submitting a paper on the topic of their choice as it relates to interests of the ALPO for presentation at our 2006 conference.

For more information, e-mail to *poshedly@bellsouth.net*

ALPO Membership Online

The ALPO now 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 inside back cover of this Journal for details.

Interest Section Reports

Computing Section

By Kim Hay, coordinator

We are always looking for what you the members of ALPO would like from the ALPOCS and how we can serve you better. If you have any comments or suggestions contact Kim Hay, at *kimhay@kingston.net*

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

Lunar & Planetary Training Program

By 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

Inside the ALPO
Member, section and activity news (continued)

Instruments Section
By 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/*

Observing Section Reports

Eclipse Section
By Mike Reynolds, coordinator

Reports and photos continue to trickle in from last year's April 8 total-annular eclipse (sometimes called a "hybrid"). The mechanics of this solar eclipse was such that the total phase was only visible at sea. Since the Moon's diameter was very close to that of the Sun, the eclipse could be seen as an annular on either end of the path and total nearer the center of the path. Three cruise ships attempted the total and JALPO is happy to report that all three saw the brief totality.

For two of the ships, the weather meant the eclipse was high drama. Those aboard the m/s Paul Gauguin literally had clouds seconds before totality; with about 30 seconds until second contact, a sliver of the Sun appeared through the high cirrus cloud deck. The "Diamond Ring" burst into all of its glory as the Sun and Moon continued to move towards the one clear opening from the clouds. Then totality – a beautiful set of prominences, chromosphere, and an almost-rectangular-shaped corona – greeted a cheering crowd. I have seen some cry at totality, but this was so dramatic that nearly every woman I talked to said she cried, and even several men admitted to shedding a few tears. But alas – since it was a total-annular eclipse – totality was over after about 36 seconds.

The stacking of eclipse images is starting to reach a real art form. One example of this is a series of photos taken not only through four different instruments, but from two different cruise ships! An article on eclipse photo stacking will appear in a future issue of this Journal.

Now we look ahead to 2006 and a much-longer total solar eclipse on March 29. The path of totality starts in Brazil, but the real show will happen as it crosses Africa, moves into the Mediterranean, to Turkey and on to its end in Siberia and Mongolia. A number of expeditions are going everywhere from Niger, to Libya, to Egypt, to Turkey, and even cruise ships in the Mediterranean; maximum length of totality is a little over four minutes (specifically, 4 minutes 7 seconds). If weather holds out, a large number of people will see this eclipse, if tour bookings are any indication.

Please send your reports – including your name, address, site where you observed the eclipse, instrument(s) used, and description (including any timings) – along with photographs and permission to publish in JALPO (along with photographic information) to the ALPO Eclipse Section Coordinator. Please also note a new address for the ALPO Eclipse Section Coordina-

Total Solar Eclipse, image taken 8 April 2005, Location: m/s Paul Gauguin (will need to "find" our GPS location data; Instrumentation: William Optics 80 mm Semi-APO (OTA), tripod-mounted Canon digital 10D body, direct objective, exposure 1/60 second at ASA 400; Seeing: some high cirrus clouds during exposure, eclipsed Sun into a clear spot moments later.

Inside the ALPO
Member, section and activity news (continued)

tor: Mike Reynolds, Ph.D., 604 11th Avenue North Jacksonville Beach FL 32250.

Please note that my e-mail address has changed; *Astrogator90@comcast.net*

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

Meteors Section

By Robert Lunsford, coordinator

2005 was a challenge to meteor observers as most of the major annual meteor showers had to contend with a bright Moon. Data are still arriving, especially from observations during the showers of December. These data will be published and discussed in an upcoming issue of the *Meteors Section Newsletter*.

Assistant Recorder Robin Gray and myself got together in the Mojave Desert during the Quadrantid meteor shower in early January. It was a good opportunity to get together and discuss the state of the meteors section. Since we both own telescopes we also discussed our involvement and contributions in other ALPO sections. Our meteor observations were plagued with clouds and rain, but at least data and video were obtained on the night of maximum activity.

2006 is much more favorable for meteor observing and we look forward to receiving more observations, especially from those who were unable to observe last year.

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

Comets Section

By 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/meteor.html

Solar Section

By Kim Hay, acting coordinator

Recently submitted observations may be viewed on the Web at *http://www.lpl.arizona.edu/~rhill/alpo/solstuff/recobs.html* Join the ALPO Solar Section e-mail list by visiting the Solar group at *http://groups.yahoo.com/group/Solar-ALPO/* Submit all observations to rick2d2@sbcglobal.net Visit the ALPO Solar Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/solar.html

Mercury Section

By Frank J. Melillo, coordinator

(The 2003 Mercury Apparitions Report appears in this issue.)

In December 2005, Mercury displayed another fine morning apparition as seen from our northern hemisphere. This apparition was similar to the one in December 2004. We had more opportunity to observe, sketch and image the area around 280° west longitude, which is the portion of the planet unmapped by the Mariner 10 visit.

Within the last five years, we have had numerous observations of this dark circular feature which is called “Solitudo Amphrodites / Skinakas Basin”. It is becoming more accepted that this feature may be real and not just a visual anomaly. Our goal is to concentrate on the 280° west longitude area and try to confirm its features before the MESSENGER spacecraft arrives. Observers should e-mail all notes and data to this section at *FrankJ12@aol.com*

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

Venus Section

By Julius Benton, coordinator

Analysis of the observations and images from 2003-04 Eastern (Evening) Apparition is complete and will appear in this Journal shortly, followed later by a report on the 2004-05 Western (Morning) apparition of Venus that concluded with Superior Conjunction 2005 March 31 once the report has been completed.

Inside the ALPO
Member, section and activity news *(continued)*

In Passing:
Erwin V D Velden, 1966 - 2005

It is with great sadness we have learned of the passing of Erwin V D Velden of Brisbane, Australia, on September 27, 2005. He was age 39, and died unexpectedly of natural causes. Says Frank Melillo, ALPO Mercury Section coordinator, "Erwin was indeed a great friend, a great adviser and a great observer to our Mercury group. He contributed many observations of Mercury and he was one of the most active planetary imagers in Australia. He would continue every chance he had to make more observations when Mercury's elongation was favorable for viewing from our southern hemisphere." Frank adds that some of Mr. Velden's great images showed possible white spots on Mercury, areas which may be crater ejecta. Mr. Velden's ashes were to be placed on a private observing site in Leyburn, Queensland, a favorite observation spot from which he made many beautiful photographs.

A tribute by his friends to Mr. Velden can be found at:*http://www.pbase.com/terrylovejoy/erwins_modded_d70_gallery*

(The 2001-2002 Western (Morning) Apparition Report appears in this issue.)

The 2005-06 Eastern (Evening) Apparition of Venus concluded on 2006 January 14 as the planet passed through its waning phases (gibbous through crescentic phases) and reached Inferior Conjunction with the Sun. Note that Venus progressed during this time from its near-minimal angular diameter of around 10".0 (when farthest from the Earth) and almost fully illuminated disk, through successive waning phases, culminating in a thin crescent and near-maximum angular diameter of roughly 62".5 just prior to inferior conjunction and closest approach to the Earth. Observers saw the leading side of Venus during this interval, and because the planet rotates in a retrograde sense, a view from terrestrial dusk means that it was largely the dusk hemisphere of Venus was observed.

Over 200 integrated light and ultraviolet CCD images of Venus were submitted during 2005-06 Eastern (Evening) Apparition that reveal considerable atmospheric detail. Comparisons of images made at roughly the same time and on the same date (simultaneous observations) show similar cloud patterns in the UV, and in a few cases, there has been good correspondence with drawings made on the same date using W47 (violet) filters. A greater level of confidence in our results improves as observers make an effort to do simultaneous observations, and the ALPO Venus Section is stressing combined visual observations and CCD imaging for comparative analysis of resultant data.

There is also a definite need for more ultraviolet imaging of Venus simultaneously with visual observations; for example, some observers apparently have a slight visual sensitivity in the near UV range, whereby they report radial dusky features that are readily apparent on UV photographs and images.

Sample images of Venus for 2005-06 accompany this report.

The 2006 Western (Morning) Apparition of Venus now begins rapidly after Inferior Conjunction on 2006 January 14, so observers should start looking for the planet right before sunrise in late January and into early February. Who will be the first to see or image Venus during the 2006 apparition? The planet will reach Greatest Elongation West of 47° on 2006 March 25, then progressively become less conspicuous as the planet moves toward Superior Conjunction on 2006 October 27.

Inside the ALPO
Member, section and activity news *(continued)*

Recall that Venus proceeds through waxing (growing) phases during this apparition, yet diminishes in angular diameter from as much as 62" across early in the apparition to 10" right before Superior Conjunction (a progression from crescent through gibbous phases), and we see Venus' trailing hemisphere and the dawn side of the planet at the time of terrestrial sunrise. Therefore, to repeat, observers should start observations right away and submit regular CCD and webcam images, as well as carefully executed drawings, made at roughly the same time and on the same date (simultaneous observations). A greater level of confidence in our results improves as observers make an effort to do simultaneous observations, and the ALPO Venus Section is stressing combined visual observations and CCD imaging for comparative analysis of resultant data.

Side-by-side UV and IR images of Venus taken on 2005 November 29 from 16:20-16:38UT by David Arditti of Edgware, UK, using a Philips ToUcam and a 25.4 cm (10.0 in) Dall-Kirkham telescope in fair seeing. No other image details available.

It is extremely important for all observers submitting observations, especially those contributing images, to include all of the basic information requested on the standard observing forms (e.g., a few observers sometimes neglect to include their full name and address, the date and time of their observations in UT, instrumentation details, etc.).

ALPO patrols for sightings of the Ashen Light are continuing during every apparition. Constant monitoring of the planet for the presence of this phenomenon by a large number of observers (ideally participating in a simultaneous observing program) remains important as a means of improving our chances of capturing confirmed dark hemisphere events. Imaging with CCDs and webcams to attempt to capture the faint glow on the dark hemisphere at crescentic phases is an important endeavor that must continue at the start of 2006.

It is the ultimate goal of the ALPO Venus Section to attempt to assemble a completely homogeneous mass of accurate, reliable observational data collected over many apparitions, permitting an exhaustive statistical analysis. It is hoped that we might derive enough from painstaking observations and analysis to help provide some answers to questions that continue to perplex us about Venus.

Observations of the atmosphere of Venus are organized into the following routine programs:

- Visual observation and categorization of atmospheric details in dark, twilight, and daylight skies.
- Drawings of atmospheric phenomena.
- Observation of cusps, cusp-caps, and cusp-bands, including defining the morphology and degree of extension of cusps.
- Observation of dark hemisphere phenomena, including monitoring visibility of the Ashen Light.
- Observation of terminator geometry (monitoring any irregularities).
- Studies of Schröter's phase phenomenon.
- Visual photometry and colorimetry of atmospheric features and phenomena.
- Routine photography (including UV photography), CCD imaging, photoelectric photometry, and videography of Venus.

Inside the ALPO
Member, section and activity news (continued)

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 Meteoritic Impact Search
By Brian Cudnik, coordinator

The section continued to be rather active in 2005 as several observing opportunities coinciding with annual meteor showers were coordinated. Showers active with the Moon favorably placed and which have been coordinated for observations include the Quadrantids in January, the South Delta Aquarids in July, the Perseids in August, and the Puppids and Ursids in December. In addition, a search was made for the impact of Taurid objects at the Moon in early November 2005, and also the Quadrantids of January 2006.

A total of 6 impact candidates was reported in 2005, and all but two were outside of the coordinated observation intervals listed above. The event of 12 February was possibly observed by two widely separated individuals, and may be two separate events, but the lack of certainty in the times of observation limits the ability to render this as a confirmed event. To date, none of these have been confirmed, although the impact nature of the 7 November (23:41:52 UT) impact candidate appears likely, as it appears on five consecutive frames of the videotape. The event is also likely a Taurid complex object; coordinated observations of the Moon for impact were made as the month of November opened due to a high number of fireball reports here on Earth. A second impact was captured by video by Robert Spellman at 3:33:08 UT, 12 August, but this flash only appears on a single video frame. The other four events were visually observed by people looking at the Moon for other reasons; see Table 1.

In a future section report, I plan to include a comprehensive catalog of lunar impact event candidates collected during the six-year existence of the ALPO Lunar Meteoritic Impact Section. The events most likely to be true impact events will be selected, with likely cosmic ray events not included.

We will continue to coordinate watches for lunar meteoritic impacts in the coming year. Table 2 lists meteor showers and the dates of their peaks during which we plan to coordinate observations for impacts. In addition, non-shower watches may be coordinated, especially during March when the sporadic background can reach ZHR's (Zenith Hourly Rates) in excess of 10 (The ALPO LIMS website, *http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/lun-impacts* will include any additional campaigns).

Table 1: Lunar Meteoritic Impact Candidates for 2005

Date (2005)	Time (UT)	Mag.	Location on Moon	Observer, Location
12 Feb. (2 events?)	~0:08 and / or 0:13	+1.0 and / or +4.0 (visual)	Approx. 6° South, approx. 17° East (mag. 1.0 event)	Peter Jevne and Roger Venable, USA
14 April	18:32.5	Unknown. (visual)	Near Archimedes (17 sec. duration)	Antonino Brosio, Italy
12 July	01:18	-3.0 to -4.0 (visual)	Northern Hemisphere of Earthshine	William Watson, USA
12 August	3:33:08	Unknown. (video)	East of Mare Humorum	Robert Spellman, USA
07 Nov.	23:41:52	+7.0 (video)	Near edge of Mare Imbrium	Rob Suggs, USA
31 Dec.	23:57:45	Approx. -3.0	Mare Tranquillitatis (most likely near the crater Ross or Plinius)	Kenneth Drake, USA

Inside the ALPO
Member, section and activity news (continued)

Table 2: Selected Meteor Showers of Interest to the ALPO LIMS

Shower	UT Date & Time	Earth-Based ZHR	Moon Phase and Area of Activity
Lyrids	10:55, 22 Apr	15	Waning crescent, NW quadrant
Eta Aquarids	5:51, 6 May	60	Waxing gibbous, entire disk
South Delta Aquarids	6:53, 28 July	20	Waxing crescent, entire disk
Aurigids	6:05, 1 Sep	10	Just past First Quarter, entire disk
Taurid Complex	Early Nov	Varies	Waxing gibbous, NE quadrant
Leonids	17:47, 17 Nov	100	Waning crescent, NW quadrant
Geminids	5:34, 14 Dec	120	Waning crescent, western half
Ursids	18:42, 22 Dec	10	Waxing crescent, northern half

The Date and Time reflect the peak times at Earth's location; the peak at the Moon can be anywhere from 7 hours before (last quarter, morning sky) to 7 hours after (first quarter, evening sky). Note that "Moon Phase" refers to the Moon's disk as seen with the unaided eye or binoculars, that is, the right half of the Moon is the western half, and so forth. Also note that a mild outburst of Leonid activity is expected in November 2006.

Work continues on the *Observer's Guide to Lunar Meteoritic Phenomena* and is nearing completion. Final editing of the manuscript, the designation and insertion of figures, and a final check on the configuration of the work is all that is needed before sending the manuscript to a publisher (yet to be selected). I hope to have this completed by the summer of 2006.

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

————————————

Lunar Topographical Studies
William M. Dembowski, FRAS
acting section coordinator

The ALPO Lunar Topographical Studies Section continues to be quite active. The latest activity (though not a formal observing program) is called "Focus On". Here, members are assigned a specific feature or class of features to observe. Their observations are forwarded to this ALPO section coordinator and then incorporated into a bi-monthly report which is published in the ALPO Lunar Section's own monthly newsletter, *The Lunar Observer*.

Recent assignments have included Mare Imbrium, Mare Nectaris, Gassendi, and Eratosthenes. Observations received in response to "Focus On" assignments have included electronic images, sketches, colorimetric analyses, and vertical studies of the feature. Participation has been outstanding.

The Lunar Observer, now in its 10th year of publication, can be found at *http://www.zone-vx.com/tlo.pdf* with over a year's worth of back issues archived at *http://www.zone-vx.com/tlo_back.html*

Visit the ALPO Lunar Topographical Studies Section on the World Wide Web at *http://www.zone-vx.com/alpo_topo.htm*

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Lunar Dome Survey
Marvin Huddleston, FRAS
coordinator

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

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Lunar Selected Areas Program: A Request for Observations
By Julius Benton, coordinator

The success of the ALPO Lunar Selected Areas Program (SAP) is dependent upon long-term systematic observations of specific lunar features not only throughout a given lunation, but also from lunation to lunation for many years. Such regular and careful monitoring will familiarize one with the normal, yet often complex, changes in appearance that many features undergo from lunar sunrise to sunset, and it will be possible for the individual to recognize anomalous phenomena more readily from one lunation to the next, should they occur.

Inside the ALPO
Member, section and activity news (continued)

Special inherent talents for drawing lunar features, although definitely helpful, are not necessary, nor is exceptional visual acuity. The most fundamental and essential prerequisite for participation in the Selected Areas Program is the willingness to follow the Moon and the chosen feature(s) for many consecutive lunations, year after year. Scientific objectivity is mandatory, whereby the observer must develop a constant practice of recording precisely what is seen at the eyepiece, not what one might expect to see (as may be derived from one's previous observations or from studies of published reports from other individuals). Should there be any doubt whatsoever about what is perceived, the observer must routinely note such uncertainties. The resulting data will be far more reliable and of lasting value.

While initial efforts to detect rather delicate details on the lunar surface may result in some disappointment, persistent observations will bring about the reward of eventual successful perception (i.e., through training of the eye) of subtle features at the threshold of vision. The joy of recording phenomena or details hitherto unrecognized is reserved largely for the person who has maintained the perseverance to observe the Moon regularly.

While there is a definite requirement to know how various lunar features change their normal appearance throughout a lunation in response to variations in phase angle, even more intriguing are those lunar features that behave in an unusual, sometimes unpredictable, and non-repeating manner as solar illumination changes. The ALPO Lunar Selected Areas Program (SAP) is chiefly concerned with systematically monitoring regular and cyclical long-term variations during many lunations of specifically designated, or *"selected,"* areas on the Moon. The SAP is designed to intensively study and document for each of these features the *normal* albedo changes in response to conditions of varying solar illumination. The program is equally concerned with the following possible *anomalous* phenomena:

- *Tonal and/or Color Variations*. These are variations in tone or color, or in the size and shape of a region of tone or color, that is not related to changing illumination (i.e., the phenomenon does not exactly repeat from lunation to lunation). Areas in lunar features most subject to such anomalous behavior are *radial bands, dark patches, and nimbi or haloes*.

- *Shape and Size Changes*. These are variations in the appearance and morphology of a feature that cannot be traced to changing solar illumination or libration.

- *Shadow Anomalies*. These are deviations of lunar shadows away from the theoretical normal absolute black condition, or a shadow with an anomalous shape or hue, in most cases not attributable to changing phase angle.

- *Appearance or Disappearance of Features*. Although exceedingly improbable and controversial, these are features that seem to be present now, but appear to be absent on earlier maps or photographs; or features that are no longer visible today but which are clearly indicated on earlier maps or photographs.

- *Features Exposed to Earthshine*. These are any anomalous tonal or albedo phenomena (any of the categories listed here) that occur under the conditions of Earthshine.

- *Eclipse-Induced Phenomena*. These are features that exhibit anomalous characteristics (first, second and third bulleted items above) during and after an eclipse, compared with previous eclipses when the same areas were monitored.

Most of the phenomena listed above are related to anomalous variations in morphology, tone (albedo), or color, which cannot be attributed to changing solar angle (phase angle) or libration, and which clearly *do not* repeat systematically from lunation to lunation. As stated earlier, however, it is essential in our program *to establish a record of both the normal and abnormal behavior of suspect lunar areas* under all conditions of illumination.

The lunar features that are currently designated as the *official* lunar formations that are being monitored as part of the SAP appear below.

Feature	Selenographic Longitude	Selenographic Latitude
Atlas	43E	46N
Copernicus	20 W	9 N
Plato	9 W	51 N
Theophilus	26 E	11 S
Tycho	11 W	42 S
Alphonsus	4 W	13 S
Aristarchus	47 W	23 N
(Nearby Herodotus is also considered a part of the program with its environs)		

Inside the ALPO
Member, section and activity news (continued)

All of the areas listed above were chosen because they are relatively easy to find, convenient to observe, and have historically shown numerous instances of suspected anomalies. Complete outline charts and observing forms are available from the ALPO Lunar Section for each of the features noted.

The standard SAP procedure is to visually monitor as many of the selected lunar features as possible throughout successive lunations, employing established systematic, objective methods of observation. Observers should be familiar with their telescopes and accessories, how to recognize scattered or reflected light, irradiation, as well as aberrations caused by the eye, the instrument, and the atmosphere.

Unfortunately, observer participation in the ALPO Lunar Selected Areas Program has been very poor in recent years, and we need a team of individuals willing to observe and record their observations on a consistent basis.

A more complete discussion of the Selected Areas Program can be found in *The ALPO Selected Areas Program: A Manual for Visual Observations*, available from the ALPO Lunar Section. Individuals interested in participating in our programs are encouraged to contact the author for further information and assistance.

Visit the ALPO Lunar Selected Areas Program on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/selarea.html

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Lunar Transient Phenomena
By Dr Anthony Cook, coordinator

During 2005, observations were received from observers from Brazil, Canada, Italy, Puerto Rico, UK and the USA. These are summarized monthly in an LTP newsletter which is e-mailed to all contributing observers and which also appears as part of *The Lunar Observer* newsletter. More detailed descriptions of observations received for the current month, and for previous months, can be found on the following web site: *http://www.cs.nott.ac.uk/~acc/Lunar/tlp.htm*

Our aim still is to try to disprove many of the past 1,468 reports contained within the 1978 NASA LTP catalog; during 2005, doubt was cast on 18 past observations based upon re-observing under the same illumination (and where possible, the same libration). For these 18 LTP reports, we were able to show that these were probably normal appearances.

The same technique, though, was also unable to disprove other past LTP reports. For example, Antonio Marino (UAI, Italy) managed to capture images of the Aristarchus area on 2005 Jul 18 at the same illumination (+/-0.5 deg) as the famous Greenacre and Barr LTP observation. Antonio's high resolution monochrome images were then used to help model where spurious color should have been seen back in 1963; but no matter what position angle was used for spectral dispersion, it was not possible to generate the strong red colours seen at specific locations by Greenacre and Barr. This therefore suggests strongly that Greenacre and Barr may have witnessed an LTP back in 1963 and were NOT mistaken by observing spurious colour as some have suggested.

During 2005, eight new reports were received that could be classed tentatively as LTP, though it should be stressed that these are all "unconfirmed observations", most of which are under investigation, i.e., trying to find past observations at the same illumination to determine whether these are normal or abnormal appearances. The observations are listed in the table that accompanies this article (see past issues of *The Lunar Observer* newsletter for full descriptions) and if any observers have other images also taken near these times, then please send them to me at *acc@cs.nott.ac.uk*

Date, Time	Subject	Observer
Apr 14 UT ~18:32	Earthshine	Antonio Brosio (UAI report)
Jun 13 UT 16:00-16:30	(not stated)	Jolio Lobo
Jul 11 UT 01:18	Earthshine	William Watson
Aug 13 UT 00:07-00:29	Herschel	Daniel del Valle Hernandez
Sep 12 UT 00:40-01:02	Rima Birt	Daniel del Valle Hernandez
Oct 17 UT 05:12	Maedler event	Robin Gray
Nov 13 UT 04:50-04:57	near Mersenius	Glen Ward
Dec 10 UT 20:46	Plato	Clive Brook

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Observations submitted to the LTP section are not just restricted to LTP studies, but in the case of high resolution images and sketches, can be of immense use to other coordinators of ALPO lunar sections. So we consider our LTP observing program to be multi purpose.

Finally, I would like to thank this section's assistant coordinator, David Darling, who helped enormously during Jan-May 2005, whilst I was busy preparing lecturing material for students at my university.

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/*

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Mars Section

By Dan Troiani, coordinator & Daniel P. Joyce, assistant coordinator

So good have been the images of Mars at the current apparition one would think that it was nearer this time than in the historic close approach of 2003. Dust clouds had approximately the same duration and intensity as in 1990, a very similar circumstance apparition, but the regions affected have been different.

Planet Mars by Richard Jakiel, Douglasville (Atlanta), Georgia, USA. This color image is the result of 4,100 stacked images taken November 3, 2005, 05:34 UT, using a Celestron C-11 Schmidt-Cassegrain telescope at f/30 equipped with Celestron NextImage webcam. CM = 260°, D = 20.09", Phase = 0.999; south at top; seeing approx. 4.5 (scale: 1[worst] - 10 [best]). No other details provided. For more info, e-mail to rjakiel@earthlink.net

The shrunken South Polar Cap (SPC) almost completely eluded observation just before becoming enshrouded by the South Polar Hood (SPH). The North Hood was prominent as expected and has begun to weaken. Cloud activity has been about normal for the seasons. As Mars recedes both from earth and sun, dust will probably not be a factor and possibly there will be an appearance of the NPC before the approaching conjunction ends the apparition.

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

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Minor Planets Section

By Frederick Pilcher, coordinator

In *Minor Planet Bulletin*, Vol 33, No. 1, Bruce L. Gary and David Healy describe an image subtraction procedure for reducing to 1% the brightness of background stars while retaining the full brightness of a moving target. Several consecutive images at a time when the asteroid was well removed from the measuring annulus were averaged, and this average was subtracted from the target image from which the target magnitude was measured by standard methods.

With a 32-inch telescope the authors obtained a 5-hour period and 0.7 magnitude amplitude for the 20th magnitude asteroid 46053 in a crowded star field only 21 degrees from the galactic center.

This same issue of the *Minor Planet Bulletin* published lightcurves, synodic rotation periods, and amplitudes for 35 other asteroids, numbers 62, 78, 126, 264, 326, 329, 426, 522, 565, 619, 714, 1427, 1459, 1829, 1967, 2139, 2453, 2463, 4006, 4232, 4949, 5386, 5580, 5641, 6249, 6327, 6456, 6556, 6974, 8567, 10518, 12331, 30825, 42267, and 1992 UY4.

For asteroid 6249 Jennifer, John Gross in 2002 obtained a 4.95 hour period and 0.45 magnitude amplitude for a standard bimodal lightcurve.

At a very different aspect, Brian Warner in 2005 obtained the same period with 0.1 magnitude amplitude for a monomodal lightcurve. The interpretation

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is that Gross observed this object at a nearly equatorial aspect while Warner observed nearly pole-on. A very interesting behavior is demonstrated. The usual two rotation maxima and minima for an elongated asteroid may be replaced by a single maximum and minimum if the asteroid is nearly pole-on.

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*

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Galilean Satellite Eclipse Timing Program

By John Westfall, assistant Jupiter Section coordinator

(A report on the Galilean Satellite Timings for the 1995-1997 apparition appears in this issue.)

The writer will be happy to supply prospective observers with an observing kit which includes an observation reporting form; you can contact him via e-mail at *johnwestfall@comcast.net*; or write to him at ALPO, P.O. Box 2447, Antioch, CA 94531-2447 USA

Jupiter Section

By Richard W. Schmude, Jr., coordinator

The 1999-2000 Jupiter Apparition report has been submitted for publication in this Journal and will appear soon. With completion of this report, the ALPO Jupiter section is now up-to-date with all of its apparition reports; they will be published here as peer reviews are completed and space permits.

Also, the first issue of the Jupiter section newsletter has been posted on the ALPO website at *http://pages.prodigy.net/macdouc/alpo/jovenews.htm*

Jupiter will be visible in the early morning hours during February and several observers are already imaging the planet.

The biggest development of note has been the emergence of a new white area in the South Equatorial Belt which was discovered by a Japanese astronomer. Please note any unusual activity in or near that location.

The North Temperate Belt may reappear at any time, so observers should note this feature as well.

Please be sure to send any observations to the ALPO Jupiter Section, c/o Dr. Richard Schmude, Jr. (e-mail to: *schmude@gdn.edu*)

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

Saturn Section

By Julius Benton, coordinator

As 2006 begins, Saturn is situated in the constellation of Cancer and shines at visual magnitude 0.1, reaching opposition on 2006 January 27 when it can be viewed throughout the night. The southern hemisphere and south face of the rings remain open to our telescopes, and the rings will reach a maximum inclination to our line of sight of about -20° right after opposition, but will diminish to -16° as the planet reaches conjunction with the Sun on 2006 August 7. The globe of Saturn on the date of opposition will be 20".5 across in equatorial diameter and 18".7 in polar diameter, while the major axis of the rings will span 46".4 and the minor axis 15".1.

Observers have already begun submitting visual observations in the form of drawings and visual numerical relative intensity estimates, as well as images captured using CCDs and webcams. A few observers have called attention to what appear to be one or more white spots near the northern edge of the SPR, but at the time of this brief summary, no other activity has been reported in Saturn's atmosphere or associated with the rings. Those who do imaging of Saturn are reminded not to neglect to attempt visual observations as well, including visual numerical relative intensity estimates (visual photometry) of Saturn's globe and ring features, since these data are very important in our study of seasonal brightness fluctuations.

Furthermore, it is extremely important for all observers submitting observations, especially those contributing images, to include all of the basic information requested on the standard observing forms (e.g., a few observers sometimes neglect to include their full name and address, the date and time of their observations in UT, instrumentation details, etc.). A

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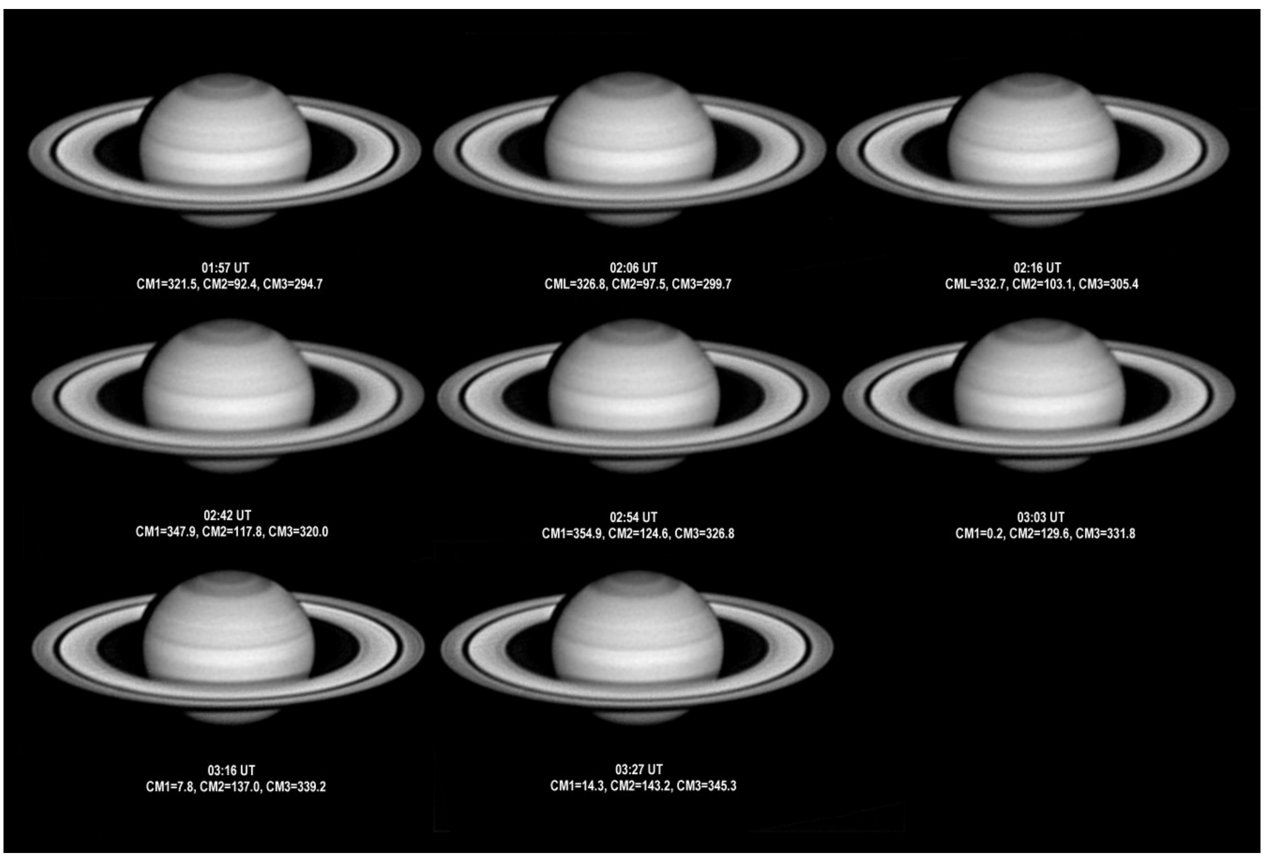
sample image selected from several submitted for this apparition accompanies this report.

Observer response during the immediately preceding 2004-05 apparition was excellent, with at least 500 observations consisting of drawings and images. Analysis of those observations is underway, with a report to follow in this Journal.

Major programs carried out by the ALPO Saturn Section include:

- 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 in addition to studies of Cassini's, Encke's, and Keeler's divisions.
- Systematic color filter observations of the bicolored aspect of the rings and watching for azimuthal brightness asymmetries around the circumference of Ring A.
- Observations of stellar occultations by Saturn's globe and rings.
- Specialized studies of Saturn during edgewise ring orientations in addition to routine studies.



Series of images of Saturn taken on 2005 December 06 from 01:57-03:27UT by Damian Peach observing from Norfolk, UK, using a Philips ToUcam and a 23.5 cm (9.25 in) SCT in good seeing conditions. See image for technical data.

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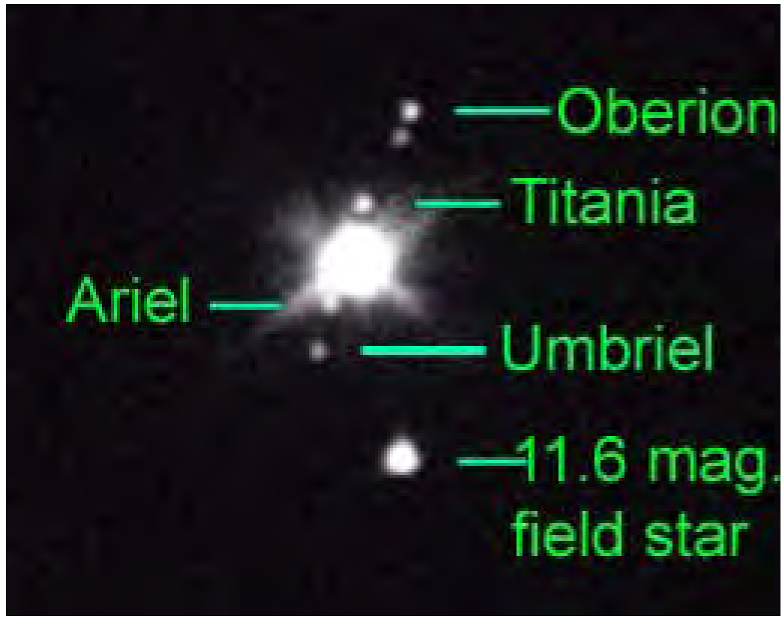
- Visual observations and magnitude estimates of Saturn's satellites.
- Multi-color photometry and spectroscopy of Titan to confirm a rotational light curve variation of 7% at 940 nm from 1990-93.
- Regular imaging of Saturn and its satellites using webcams, digital and video cameras, and CCDs (results with inexpensive webcams have been truly remarkable).

The former *Saturn Handbook* has now been discontinued and replaced by the author's new book, *Saturn and How to Observe It*, published in December 2005, and available from *Springer On-Line*, *Amazom.com*, *Barnes and Noble*, and other worldwide book outlets.

The ALPO Saturn Section is always anxious to enroll new observers, and those interested in our programs should contact the ALPO Saturn Section Coordinator on how to get started.

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn page 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*



Uranus with satellites and field star. Image taken August 14, 2005 by John Sanford. Location: Starhome Observatory, near Porterville, California, 118° 48" 18.8' west longitude, 36° 13" 28.6' north latitude. Image data: 20-second exposure using a Celestron C-14 Schmidt-Cassegrain telescope at f/4, with a Starlight XPress SXV-H9 Megapixel 16-bit cooled CCD camera equipped with a red filter. Seeing=7/10, transparency=8/10. Says Mr. Sanford, "The red filter reduces the chromatic aberration induced by the old Optec focal reducer I use, and also reduces atmospheric prismatic effects and possibly reduces the brightness of the planet vs. the satellites."

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Remote Planets Section

By Richard W. Schmude, Jr., coordinator

The planets Uranus and Neptune will be close to the Sun during February and March. Pluto, however, will be visible in the early morning hours.

During June, the Uranian moons Ariel, Umbriel and Titania will transit their planet. One important transit of Titania is predicted to occur on July 7 at 8:42 Universal time. And because Titania is darker than Uranus, Titania will appear as a small dark dot as it moves in front of the planet. Titania is only 3.1% the size of Uranus.

There will also be a very important satellite eclipse of special interest to remote planets observers with CCD cameras, webcams and software for magnitude determinations this summer. On July 2, at approximately 9:40 UT, Miranda will eclipse Ariel, causing a predicted 0.14 magnitude drop in the brightness of Ariel + Miranda. The ALPO Remote Planets Section urges all observers with the instrumentation cited here to study this event in detail and submit their results to this organization.

As for brightness measurements, Uranus continued to grow dimmer in 2005 while Neptune maintained a similar brightness compared to what it had been in 2001-2004. No word on Pluto yet. Let's see what happens in 2006.

Remote planets observers are urged to submit their own brightness measurements of Uranus, Neptune and Pluto to the ALPO Remote Planets Section, c/o Dr. Richard Schmude, Jr. (e-mail to: *schmude@gdn.edu*).

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

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From page 1 — Just What I Needed

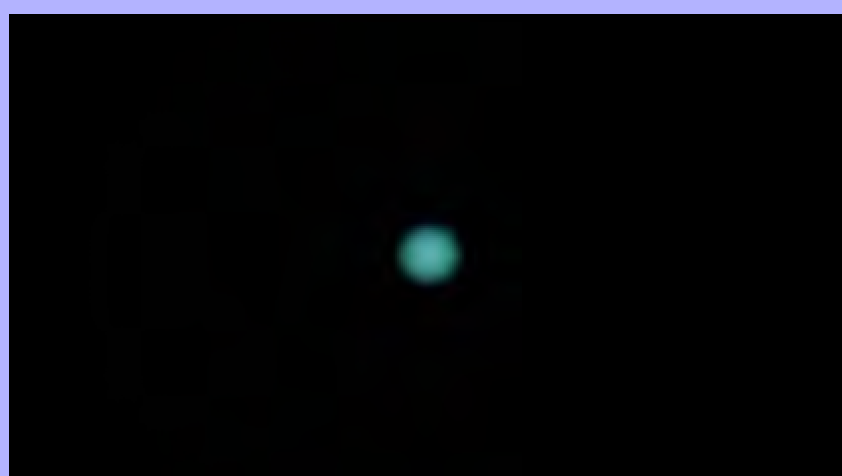
members, I sold the scope to someone who could restore it, thereby financing my very first telescope: a Vixen/Orion 80 MM. refractor on an at-az mount. Since then, I have owned a variety of telescopes and mounts, finally settling on a Meade 8" LX200 Classic SCT.

The 2003 Mars apparition got me interested in viewing and photographing the planets. I still recall the first time I saw both Uranus and Neptune. So tiny in the eyepiece, yet so beautiful! The colors that they both exhibit are delicate, yet captivating. In 2004, I was able to capture Uranus with a SAC IVc modified webcam. To do so took most of the night, but I was very proud that I could do it.

Photographing Uranus and Neptune is a challenge. For one thing, alignment of the telescope is critical. Then, after acquiring and confirming that one is indeed looking at the planetary disks, putting these remote planets on the chip of a modified webcam or Meade DSI CCD chip is even harder. A flip mirror is a critical piece of equipment. Getting the image large enough can be done with a Televue 2.5X Powermate, but the field of view diminishes, so it is important to have the planet correctly centered. The SAC IVc webcam settings allow one to still see the aqua-green color of Uranus, as well as the bluish tint to Neptune, but the Meade DSI requires a bit more tweaking to faithfully capture the view in the eyepiece — especially when you consider that the FOV is slighter smaller than that of a 9mm orthoscopic EP.

But what to do with my remote planet images besides show them to friends ("Look what I got…!)? Participating in the Deep Impact Amateur Observer's Program for Comet 9P/Tempel 1 got me interested in sharing my images with those who could put them to use. I was familiar with the Mars ALPO section from the 2003 apparition, so I did a little research, and then joined ALPO in July 2005.

I have found everyone at ALPO to be most helpful, including Dr. Richard Schmude, Charles Bell, and Ken Poshedly. I am learning to document everything that I do in capturing the images of Uranus, Neptune, and their moons. I hope to be able to image and identify Pluto soon. I want to invest in a more sensitive camera and scientific filters one day. But no matter where I end up, I am honored to be a part of ALPO.



Webcam image of Uranus by ALPO member Lynn Laux of Strongsville (Cleveland), Ohio. Equipment notes: Meade 8-inch SCT LX200 Classic SCT, (D=203 mm, F=2000 mm, f/10). Image processing: *K3CCD Tools 2* used to capture 50 seconds of AVI at 10 fps. Best 70% of frames selected, aligned and stacked using *K3CCD Tools 2*. Converted to 3 frames of R, G, B Fits files. Aligned and processed in *Registax 3*. Unsharp mask, conversion to JPEG in *Paint Shop Pro 8*. Note that green coloration of the planet is due to its methane atmosphere absorbing other colors, and this view is representative of what can be seen of Uranus through a telescope. (Source: http://www.starrynight.com/sntimes/2005-08.html

Book Review:
The Clementine Atlas of the Moon

By Ben Bussey & Paul D. Spuds; published by Cambridge University Press, 40 West 20th Street, New York, 10011-4211. 2004. 316 pages. Price: $80, clothbound, ISBN 0-512-81528-2

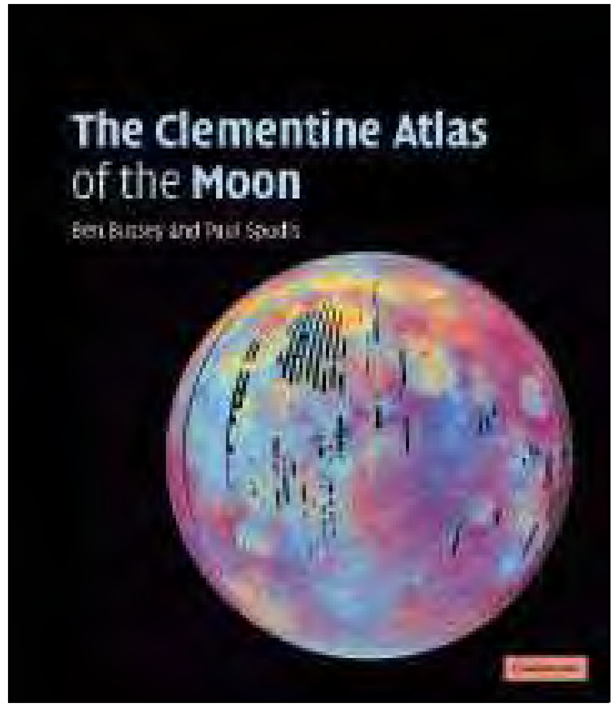
Review by Robert A. Garfinkle, FRAS
E-mail to ragarf@earthlink.net

In 1994, the United States Clementine mission orbited the Moon and returned some of the best digital images taken of the entire surface. These images have been available on a set of 15 CD-ROMs from the US Geological Survey for several years, but until the publication of *The Clementine Atlas of the Moon*, they had not been published in their entirety in book form. For students of the Moon, this is one of the best photographic lunar atlas reference books, because it covers almost the entire lunar surface (99 percent). The field of books published using the 1960s Orbiter satellite images all lack images of the farside and poor images of the marginal zones. These older books are hindered by faulty image processing, both in space and on Earth, which left dots and dark lines on the images.

After the opening chapter, which gives a very brief introduction to the motions, properties and geologic history of the Moon, the book then focuses on the Clementine mission and the imagery taken by the spacecraft. Eight full-color plates show the topography of the Moon based on the spacecraft's laser ranging instrument; maps showing the iron, titanium, and thorium content of the surface; the geological history of the surface; and the epithermal (medium-energy neutrons) flux from the surface. The text explains in non-technical terms what you are seeing.

The main feature of the book is the 144 maps based on the Clementine imagery taken with the ultraviolet-visual instrument using the on-board 750 nm filter. The lunar surface is divided into the same quadrangles used to produce the *Lunar Aeronautical Charts* (LAC) maps in the 1960s to the 1980s. The scale for most of the charts is about 1 cm to 25 km on the lunar surface. The proposed maps for the limb areas and the farside were never completed nor published, but the authors have divided the atlas based on the proposed mapping scheme. The layout is that on the left-hand page is the Clementine UV-visual image, with the lines of longitude and latitude drawn on them. On the facing right-hand page is an annotated shaded (soft-focus grey) relief map covering the same area at the same scale. The U.S. Geological Survey in Flagstaff, Arizona, produced the hand-airbrushed shaded relief maps. On the right-hand page, the authors have added the names and Roman-letter designations of the features shown.

A nice and helpful touch is that around the perimeter of the right-hand maps are the numbers for the adjoining maps.



One problem that the authors could not overcome is the fact that the Clementine UV-visual imagery shows the high latitude features with shaded relief (low solar angles) and the equatorial zones in high solar angles. The equatorial images appear much like the Moon does at full. Feature relief is missing, but the rays and bright spots are very visible. Another problem is the use of the Roman letter designations on the map labels for features that now have a different name, such as the crater Hill is shown as Marcobius B, its old designation. Both the old and new designations are given in the index, but the new name is not labeled on the map. I also found a few names misspelled on the maps and incorrect map pages given in the index for several features. The nomenclature list is up-to-date with the inclusion of the name Bliss, the latest name the International Astronomical Union has adopted (in 2000).

This atlas is designed primarily for study and research and because of the small scale of the images, I really do not think that the authors intended for it to be used at the telescope. It could be useful at the telescope if you are observing the marginal zones along the limb or the equatorial regions under high solar illumination. I personally am a fan of observing the bright lunar rays and this book shows them as no other lunar atlas does. You can observe the rays and bright spots and see in the relief maps what the same features look like under lower solar illumination. I like that aspect of this book. Overall, I highly recommend this book for all lunar observers of all expertise levels. Just work around the minor faults and the small scale of the images.

Feature Story:
A Solar Minimum Sunspot

By Jamey Jenkins, assistant coordinator, ALPO Solar Section

As we slip into the latest solar minimum, activity on the Sun will gradually decrease until its expected reversal near the end of 2006 (see Reference cited below). Although a general decline in activity is being experienced, the Sun often surprises us with an unexpected burst of energetic events. During Rotation 2025 (02-29 January 2005) we experienced such an event .

Throughout the 11-day period from 11 to 21 January 2005, ALPO Solar Section observers witnessed the birth and development of a large sunspot group (AR0720) as it paraded across the disk of the Sun. Particularly interesting were the day-to-day changes in 0720's appearance in white and monochromatic light. From a region containing faculae and no umbral material, a "naked eye" spot group developed within a 48-hour period. Gema Araujo reported AR0720 as being visible with the unaided eye on 12 January. Another observer, Wally Anglesea, on 13 January thought the group was "shaped like a bee".

Observers with H-alpha equipment witnessed a number of flare events, a most significant one at 06:38UT on 15 January. The resulting Coronal Mass Ejection (CME) prompted alerts for geomagnetic storm conditions and auroral watches on the 16, 18, and 19 of January.

Naturally, a burst in new solar activity fills the e-mail boxes of the ALPO Solar Section with images. This small collection of photographs is to illustrate the fine "show" displayed by AR0720 and captured by ALPO Solar Section observers. All images presented here have north at the top and east to the left.

References

- *http://science.nasa.gov/ssl/pad/solar/predict.htm, Dr. David H. Hathaway

- Data used here from Mees Solar Observatory, University of Hawaii, are produced with the support of NASA grant NAG 5-4941 and NASA contract NAS8-40801.

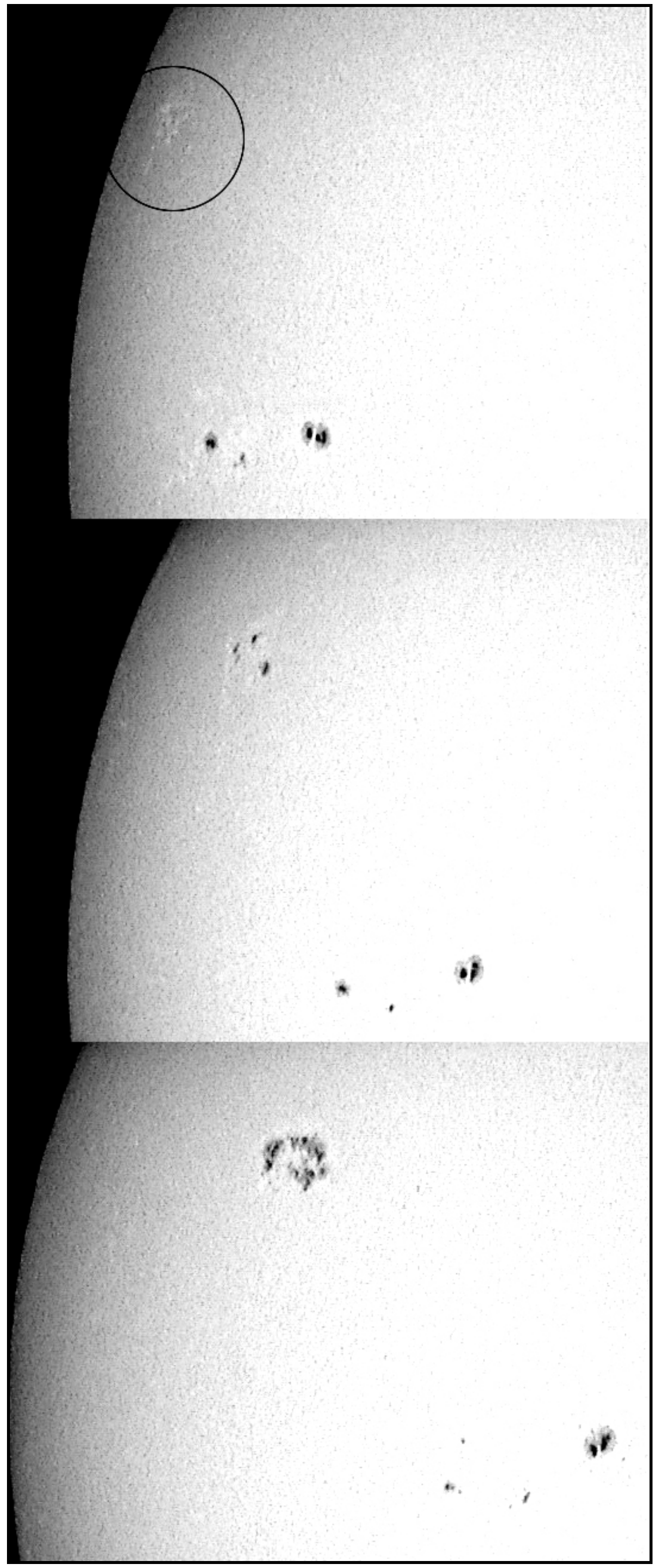


Figure 1. A series of images illustrating the rapid development of AR0720 in a 48 hour period as it rounded the east limb of the Sun. The circled region on the far left image (10 January 2005, 1139UT) is the early, just developing region with faculae. The middle image was obtained on the 11th at 1049UT. AR0720 had grown sufficiently to be seen without optical aid by the 12th as shown in the far right image at 1034UT. Provided by Gema Araujo using an 80mm f/11 refractor and a Phillips ToUcam Pro webcam, Baader AstroSolar objective filter.

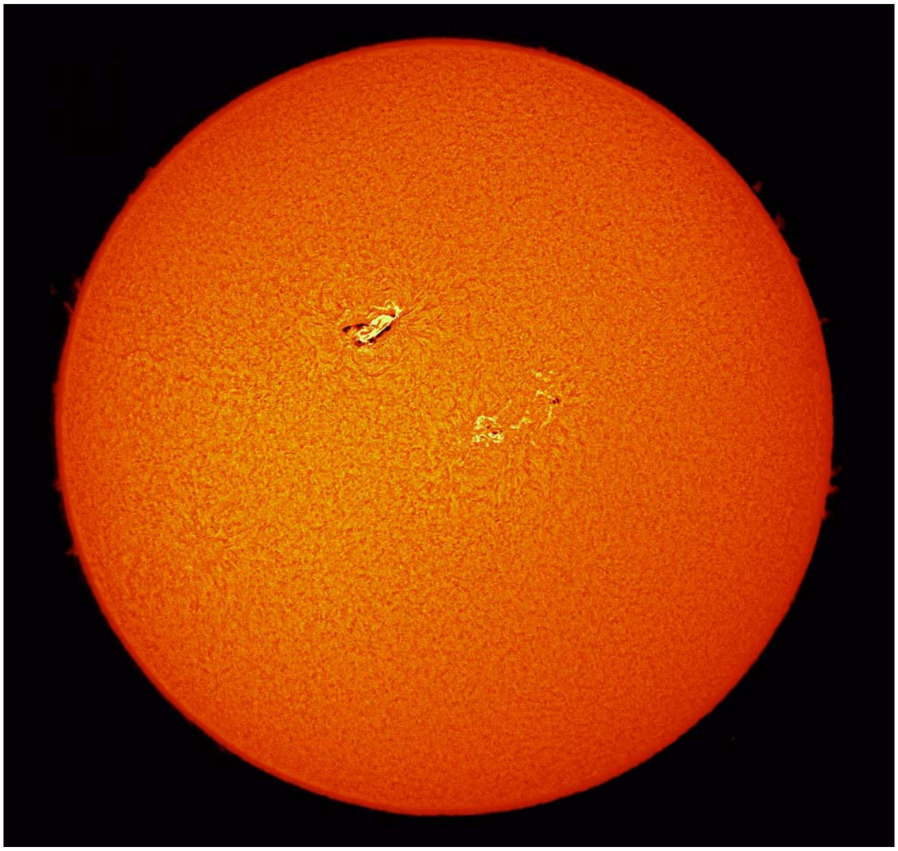


Figure 2. H-alpha observers were treated to several solar flares on 15 January 2005. Vincent Chan captured this one at 0450UT. Mr. Chan used a Borg 76ED refractor coupled with a Solarmax 40/BF10 H-alpha filter. A Nikon CP990 camera was in the afocal position.

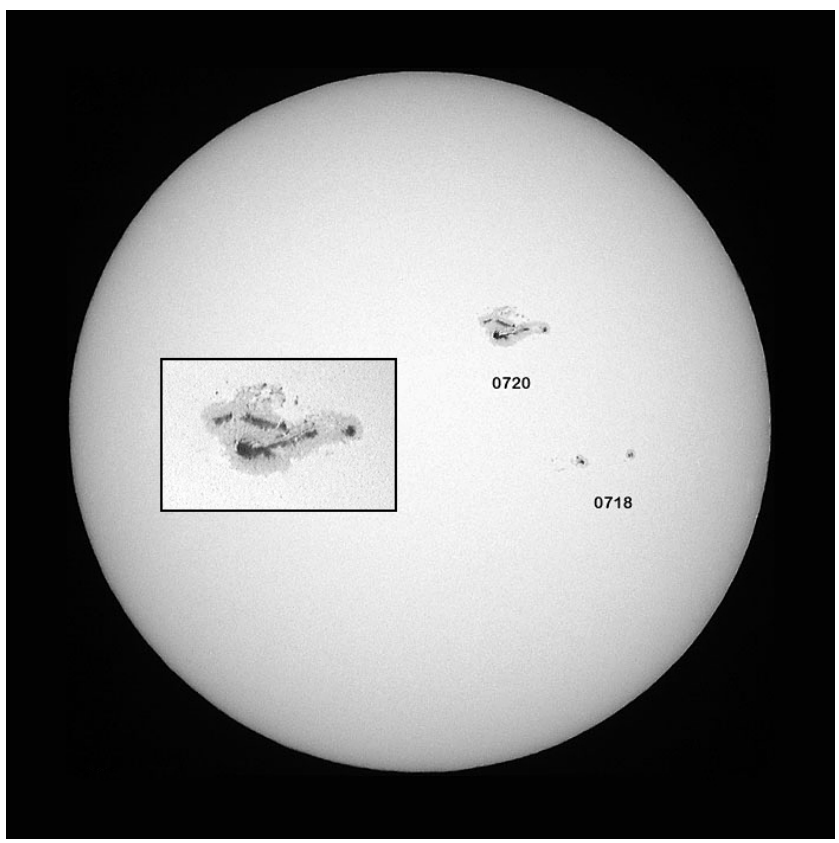


Figure 3. By the 16 January, AR0720 had grown to an extended heliographic length of 10^{o} and was displacing an area of 1620 millionths of the visible hemisphere. Howard Eskildsen obtained this whole disc image at 1744UT by using a 125/1900mm Mak-Cassegrain and a Nikon CoolPix camera. Eskildsen utilized a Baader Aperture filter and a W15 Yellow filter at the eyepiece. The inset image showing finer detail is from 1205UT by Gema Araujo.

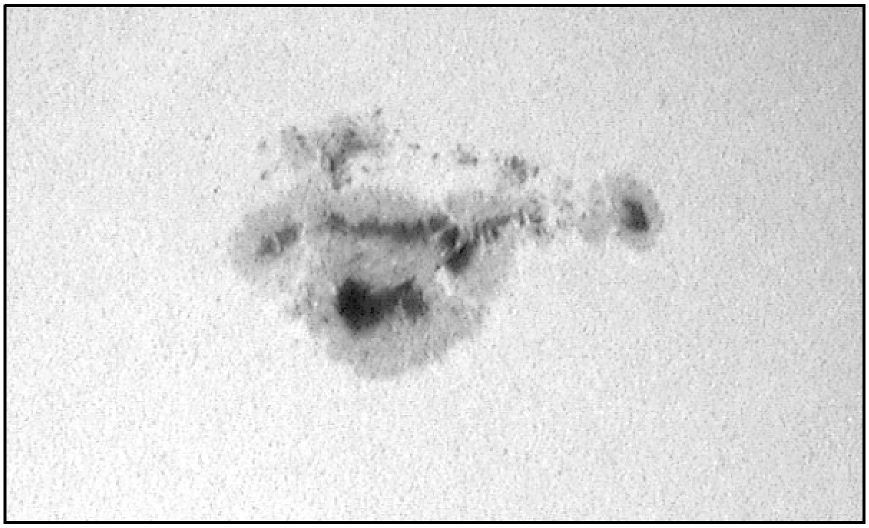


Figure 4. By the 17 January, AR0720 was classified an "Ekc" group in the McIntosh Classification system. Ekc sunspot groups are good producers of flares and AR0720 indeed held to the predictions, generating flare induced magnetic storms on Earth late on 18 January. Image by Gema Araujo at 1205UT.

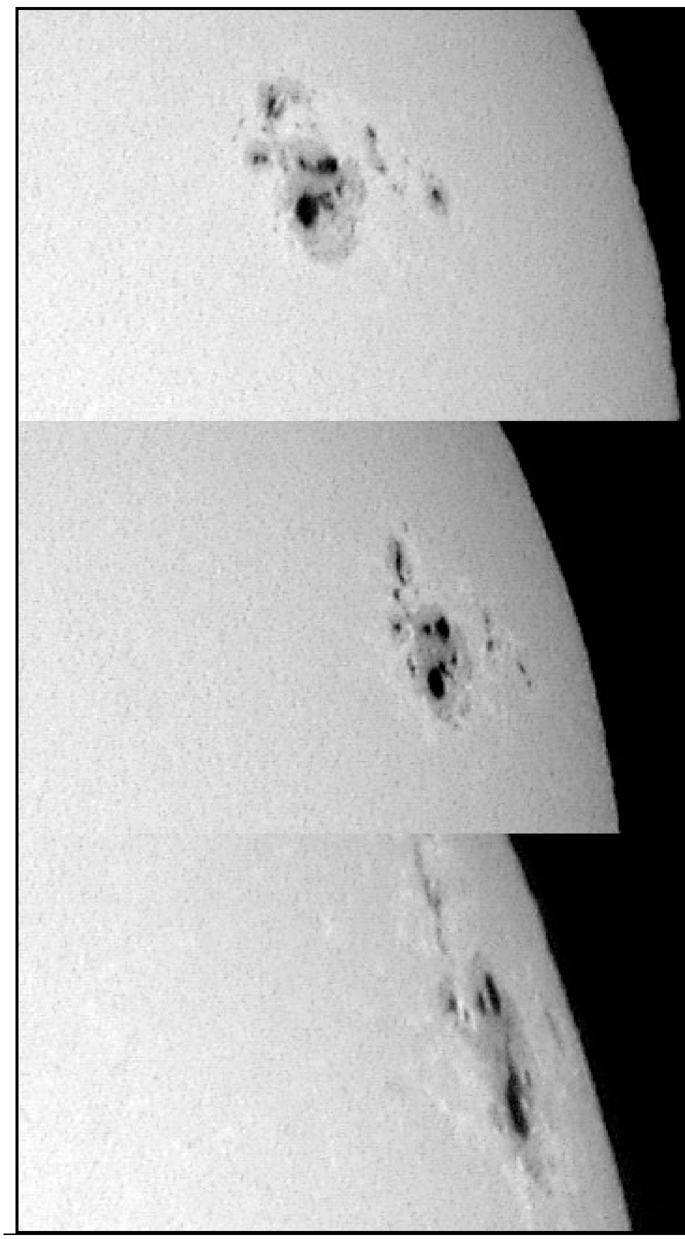


Figure 5. As AR0720 approached the western limb of the Sun, Gema Araujo imaged the group on the 19 (1144UT), 20 (1134UT), and 21 (1125UT) of January 2005. By 21 January, the Ekc group had obtained a 15º heliographic length and was still consuming 1400 millionths of solar hemisphere.

Feature Story:
Mercury Apparition Observations in 2003

By Frank J Melillo, coordinator, ALPO Mercury Section
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Abstract

The most noteworthy feature of the six apparitions of Mercury that took place in 2003, was a significant increase in the number of excellent high resolution drawings and images submitted - a total of 66 drawings, 12 CCD images and 18 webcam images from 13 observers using apertures from 9 to 20.3 cm. Features described still show good correlation with the official IAU albedo chart prepared by A. Dollfus and J. Murray (1971).

Introduction

There were six apparitions of Mercury in 2003, with three morning and three evening elongations (Table 1). In addition, the 13 observers of these apparitions (Table 2) made a significant number of independent simultaneous observations. The quality of observations has greatly improved over the years, due largely to improved techniques and Internet communication. There has also been an explosion of webcam imagery (for instance, the Phillips *ToUcam*).

A Few Words About Half-Phase

The time of Geometric Half-Phase is that time when half of Mercury is illuminated and the terminator is straight. It is NOT necessarily when the time of Greatest Elongation occurs.

At evening apparitions, Mercury is gibbous before this time and crescentic afterwards. As seen from Mercury, the Sun and the Earth are exactly 90 degrees apart. The OBSERVED phase may differ from the geometric one for a variety of reasons, e.g., atmospheric bad seeing, the dimmer lighting of the terminator, the brightness of the sky background, etc.

To mark the upcoming NASA Messenger satellite mission, Dr. Ann Sprague of the Lunar & Planetary Laboratory, and Dr. Robert Strom of the University of Arizona have produced an excellent book "Exploring Mercury: The Iron Planet". This showcases work by ALPO members — especially observations of bright albedo features — thus demonstrating the continued importance of amateur studies of the planet.

Also in 2003, Fred Grutel, science editor at *Newsweek* magazine wrote a very interesting article about Mercury for *Discover* magazine. I provided him with much information and one afternoon during an eastern elongation attempted to show him what it is like to observe Mercury during daylight hours. Unfortunately, I failed to find Mercury, but I was able to supply him with much information for his article, which was published in the April 2004 issue of *Discover.* This was the first time we were able to supply the public with a substantial amount of information about Mercury.

Apparition 1: (Morning) 11 Jan – 22 Mar

After inferior conjunction on Jan 11, Mercury entered the morning sky. This was an unfavorable apparition for northern observers. But Erwin van der Velden of Bris-

Table 1: Characteristics of the Apparitions of Mercury in 2003 (all dates UT)

Number &Type	Beginning Conjunction*	Greatest Elongation	Geometric Half-Phase	Final Conjunction	Aphelion	Perihelion
1. Morning	Jan 11 (i)	Feb 04 (25 W)	Jan 29.5	Mar 22 (s)	Feb 19	—
2. Evening	Mar 22 (s)	Apr 16 (20 E)	Apr 13.5	May 7 (i)	—	Apr 4
3 Morning	May 7 (i)	Jun 03 (25 W)	June 9.3	Jul 5 (s)	May 18	Jul 1
4. Evening	Jul 05 (s)	Aug 14 (27 E)	Aug 15.1	Sept 11 (i)	Aug 14	—
5. Morning	Sept 11 (i)	Sept 27 (18 W)	Sept 27.0	Oct 25 (s)	—	Sept 27
6. Evening	Oct 25 (s)	Dec 09 (21 E)	Dec 12.9	Dec 27 (i)	Nov 10	—

* (i) = inferior conjunction, (s) = superior conjunction

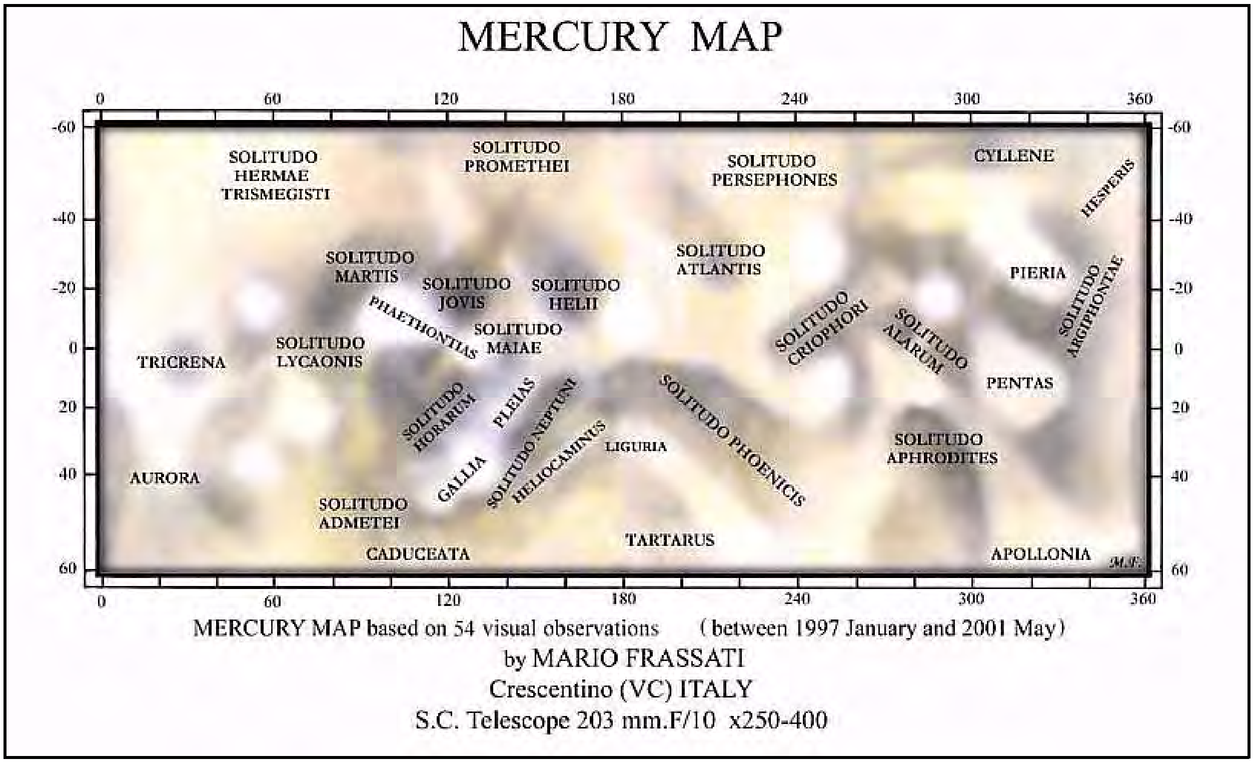

Figure 1. Mercury map by Frassati.

bane, Australia, had a perfect view of the planet as it stood vertically above the horizon at the maximum distance of nearly 25° from the Sun. This condition resulted in some fine imagery showing a bright area tentatively identified as the ejecta from the crater Kuiper.

(Figure 2) On January 30, Erwin imaged Mercury at CM=297° longitude. His image is sufficiently sharp to identify albedo features, especially the two bright regions, Pentas and Pieria. Through February 1 to 8, Mario Frassati made three drawings (from CM=309° to CM=345°). They, too, show two bright regions north and south of the equator. Frassati's three drawings are consistent with one another, suggesting that the bright features are Pieria and Pentas. On Feb 11 and 12, Velden obtained two excellent

Table 2: ALPO Observers of Mercury 2003

Observers	Location	Instrument*	Number and Type of Observations**	Apparitions Observed
Michael Amato	West Haven, CT USA	10.4 cm RR	1 D	2
Mario Frassati	Crescentino, Italy	20.3 cm SCT	18 D	1 - 6
Walter Haas	Las Cruces, NM USA	20.3 cm NT	5 D	2
Frank J Melillo	Holtsville, NY USA	20.3 cm SCT	12 CCD	2, 3, 5
Detlev Niechoy	Gottingen, Germany	20.3 cm SCT	18 D	5
Ricardo Nunes	Lisbon, Portugal	20.3 cm SCT	2 W	2, 5
Christoph Pellier	Bruz City, France	8.0 cm RL	1 W	5
Carl Roussell	Hamilton, Ontario Canada	15 cm RL	10 D	2, 3, 5
Giovanni Sostero	Udine, Italy	15 cm RR	2 W	2
Erwin V D Velden	Brisbane, Australia	20.3 cm SCT	11 W	1, 2, 3, 4
Thomas Williamson	NM USA		1 W	5
Tim Wilson	Jefferson City, MO USA	9.0 cm RR	14 D	2, 3, 4, 5, 6
Christian Wohler	Heroldstatt, Germany	20 cm NT	1 W	5

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

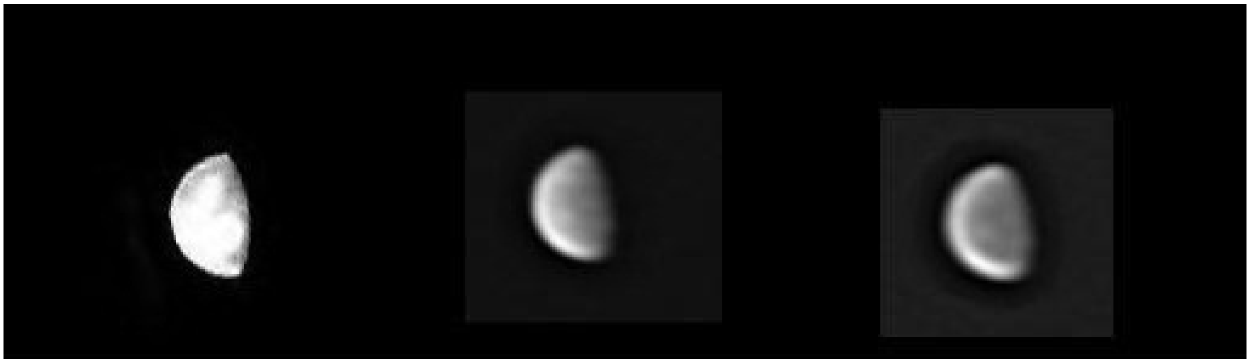

Figure 2, Apparition 1. (Left) Drawing by Mario Frassati, 6 Feb 2003, 06:10 UT, CM=335°; (Center) Webcam image by Erwin van der Velden, 11 Feb 2003, 20:15 UT, CM=3°; (Right) Webcam image by Erwin van der Velden, 12 Feb 2003, 19:45 UT, CM=7°

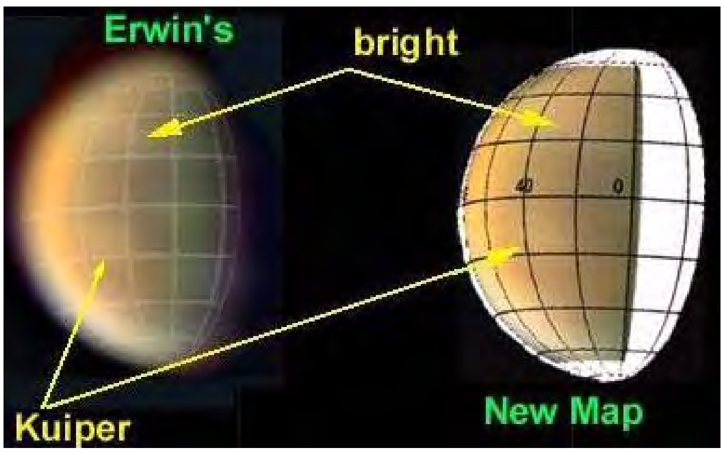

Figure 3, Apparition 1. Map of Mercury provided by observer Tim Wilson indicating possible Kuiper location observed by Velden. Each line of latitude and longitude equals 20°. At CM=3°, it is possible that ejecta ray system was captured as a bright spot. Location of Kuiper is 11° south latitude, 31° west longitude.

webcam images (CM=3° and CM=7°, respectively). Both images show a bright spot near the terminator, possibly crater ejecta, first identified by the Arecibo radar astronomers. The position of this new "radar" crater is between 340° and 360° longitude and 25 and 40° south latitude. In addition, a bright area closer to the limb which came into view might be the ejecta ray system of Kuiper (location 32° longitude and 11° south latitude; Figure 3).

At this time, it is difficult to say with assurance that Velden did indeed image the "new" crater, and the Kuiper ray system. Velden's work is certainly outstanding but his results must be repeated before we can make a positive announcement. Lately, sightings of bright spots which may be ejecta blankets have increased, but more observations are needed.

Apparition 2: (Evening) 22 Mar – 7 May

Entering the evening sky after superior conjunction on March 22, Mercury was monitored by nine observers who under reasonable conditions obtained 16 drawings, two sets of CCD images and eight webcam images. This is rather a large contribution.

(Figure 4) Tim Wilson started with his drawing of April 2. At CM=221° longitude, Solitudo Atlantis, and especially Solitudo Criophori, were seen. Ricardo Nunes of Portugal imaged the gibbous planet on April 3, (CM=225° longitude), while Frassati made two drawings on April 4 and April 8, (CM=231° and 248° longitude, respectively). He also recorded Solitudo Criophori, the most prominent albedo feature on this side of the disk. In addition, he claimed to see a possible dark feature in the north as Solitudo Phoenicis. In fact, Giovanni Sostero and Walter Haas observed on April 8. Haas observed under difficult conditions, but appears to have glimpsed traces of Solitudo Criophori, and Sostero obtained a good image of the gibbous phase.

Wilson and Frassati continued to follow Mercury (CM=256° to CM=267° longitude) and reported a prominent dusky marking, possibly Solitudo Criophori. Melillo imaged Mercury on April 12, (CM=267°), Solitido Criophori being quite obvious on the terminator. Carl Roussell of Ontario, Canada, drew this same feature the next day (CM=271°) at exactly the same place. And on April 14

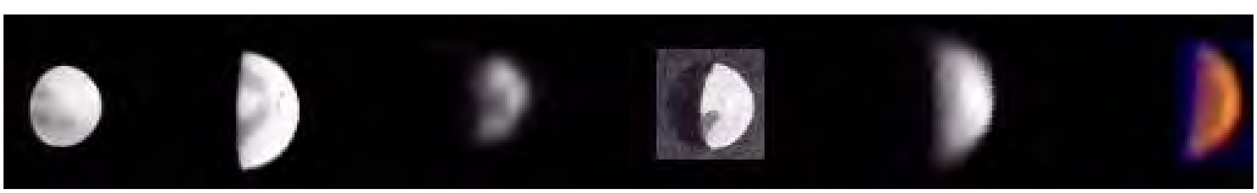

Figure 4, Apparition 2. From left: Drawing by Tim Wilson, 2 April 2003, CM=221°; Drawing by Mario Frassati, 12 April 2003, CM=267°; CCD image by Frank Melillo, 12 April 2003, CM=267°; Drawing by Carl Roussell, Hamilton, 13 April 2003, CM=271°; Webcam image by Erwin van der Velden, 13 April 2003, CM=271°; Color webcam image by Giovanni Sostero, 13 April 2003, CM=271°

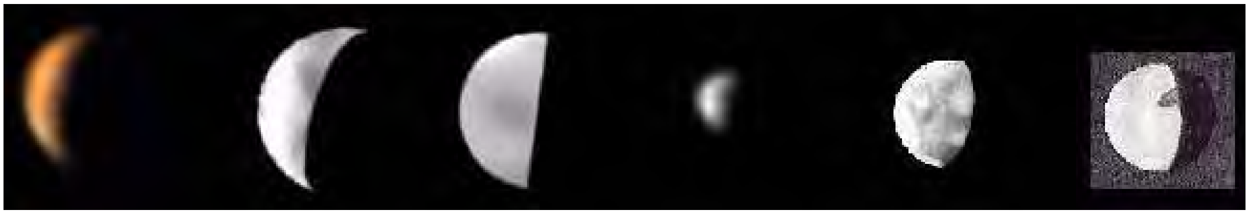

Figure 5, Apparition 3. From left: Color webcam image by Erwin van der Velden, 5 May 2003, CM=196°; Drawing by Tim Wilson, 1 June 2003, CM=206°; Drawing by Tim Wilson, 9 June 2003, CM=248°; CCD image by Frank Melillo, 10 June 2003, CM=253°; Drawing by Mario Frassati, 19 June 2003, CM=294°; Drawing by Carl Roussell, 20 June 2003, CM=300°.

(CM=275°), Michael Amato of Connecticut drew the shading area in the southern hemisphere near the equator. Velden, Sostero, Roussell, Haas and Wilson all made additional observations as Mercury's phase narrowed. They proved the details were quite difficult to see.

Greatest elongation occurred on April 16. Mercury was then standing about 20° east of the Sun. Amato, Haas, Velden, Sostero and Roussell recorded Mercury as a half-phase on April 13 and 14. Wilson's drawing of April 15 showed Mercury slightly crescentic.

Apparition 3: (Morning) 7 May 7 – 5 Jul

Mercury transited the Sun on May 7, and passed into the morning twilight. This Apparition 3 was favorable for observers on both the Earth's northern and southern hemispheres. Mercury was high in the sky from the northern hemisphere while the ecliptic was rather steep with more favorable conditions as seen from the southern hemisphere. The observations detailed here cover a period of almost a month.

(Figure 5) Erwin van der Velden imaged Mercury in the crescent phase on May 24 and May 30 (CM=162° and CM=196°, respectively). On June 1, Wilson made an excellent drawing (CM=227°) which shows Solitudo Phoenicis in the north. Velden imaged a broad image on June 5 with slight shading on the terminator. Wilson made another drawing on June 9 (CM=248°). He recorded a slight darkening along the equator near the terminator. This was possibly Solitudo Criophori, which had been prominent during the last evening apparition. Melillo imaged the next day (CM=253°) and registered a dusky marking in the north, possibly Solitudo Aphrodites. This feature was prominent during the June/July morning apparitions of 2001 and 2002. Frassati then drew Mercury on June 19 and 20, (CM=294° and 299°, respectively), and both drawings have two bright regions near the limb, tentatively identified as Pentas and Pieria. In fact, Pieria is near to the position where the recently discovered "radar" crater is located. Carl Roussell recorded what seems to have been Solitudo Aphrodites on June 20. Wilson and Frassati continued to observe during the latter part of the week. All of their drawings (CM 303° to CM=311° longitude) show dark albedo features, such as Solitudo Alarum and Criophori.

Greatest elongation occurred on June 3. Wilson drew Mercury on June 1 as a crescent approximately 34 per cent illuminated and Velden imaged it as a broad crescent on June 5, 42 per cent illuminated. Wilson drew a perfect half phase on June 9. It showed that the half phase occurred about six days after greatest elongation.

Apparition 4: (Evening) 5 Jul – 11 Sept

This was rather an unfavorable apparition for viewers in the northern hemisphere. Only six observations were received. In the southern hemisphere, Velden imaged Mercury under the best condition, while Wilson and Frassati managed to make some good observations from the northern hemisphere.

(Figure 6) Wilson made two drawings on July 13 and July 23, (CM=35° and CM=74° longitude, respectively). Both drawings show a dark spot in the southern hemisphere, probably Solitudo Martis. Velden obtained a fine image on July 30, (CM=105°). It shows a possible feature on the disk also seen by Wilson. Frassati and Wilson made excellent drawings on August 2 and 3, (CM=121° and CM=129°, respectively). Both observers recorded the same albedo features — Solitudo Martis and Jovis — in the southern hemisphere. Finally, Velden imaged the planet in the figure of the half moon on August 10 (CM=158°).

Greatest elongation occurred on August 14. Again, only Velden made an observation around that time, observing the half phase on August 10.

Apparition 5: (Morning): 11 Sept – 25 Oct

Nineteen observations were received during this apparition; the largest contribution of all, as Mercury made its finest morning appearance of the year. Also, there are many

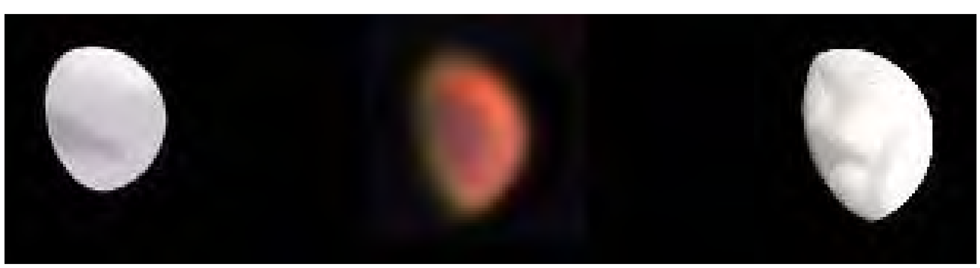

Figure 6, Apparition 4. From left: Drawing by Tim Wilson, 23 July 2003, CM=74°; Color webcam image by Erwin van der Velden, 30 July 2003, CM=105°; Drawing by Mario Frassati, 02 Aug 2003, CM=121°.

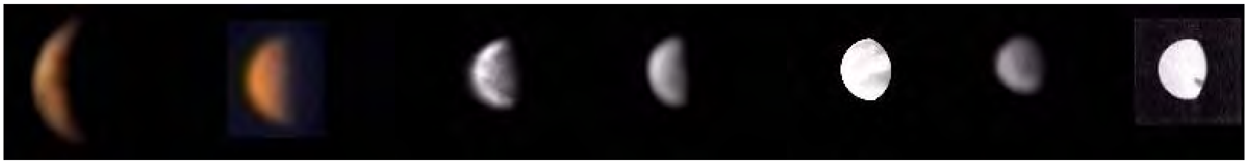

Figure 7, Apparition 5. From left: Color webcam image by Ricardo Nunes, 24 Sept 2003, CM=75°; Color webcam image by Thomas Williamson, 26 Sept 2003, CM=85°; Monochrome webcam image by Christian Wohler, 30 Sept 2003, CM=106°; CCD image by Frank Melillo, 30 Sept 2003, CM=108°; Drawing by Mario Frassati, 05 Oct 2003, CM=130°; CCD image by Frank Melillo, 31 Oct 2003, CM=131°; Drawing by Carl Roussell, 06 Oct 2003, CM=134°.

"nearly" simultaneous observations which make the results even more valuable.

Ricardo Nunes, Carl Roussell and Tim Wilson observed on Sept. 24 (CM=75° ~ 77°). During the crescent stage, they recorded a slight darkening in the south which may be Solitudo Martis. The next two days, Christophe Pellier of France, and Thomas Williamson of New Mexico (CM=81° and CM=85°) took webcam images which show Mercury as a broad crescent and half phase the next day. The images were showing only slight shading along the terminator. Detlev Niechoy of Germany, sketched the planet in the interval Sept. 25 to 29 (CM=85° to 103°). His drawings show slight shading on the terminator, on the south side, probably Solitudo Martis. On Sept 30, we have three more observations done on the same day. Roussell (drawing), newcomer Christian Wohler of Germany (webcam image) and Melillo (CCD image) observed on Sept 30, (CM=106°~108°). All spotted the same albedo features Solitudo Martis and Jovis in the south.

Roussell and Niechoy observed on Oct. 1 (CM=113°/114°) and drew Solitudo Martis and Jovis, south of equator. Niechoy saw an additional marking in the north, possibly Solitudo Horarum. On Oct 5, Frassati, Roussell, and Melillo observed Mercury at almost the same time (CM=130°/131°). Frassati and Roussell drew Solitudo Jovis and Solitudo Maiae, and Melillo imaged the same features. Roussell observed on the next two days and recorded the same markings (CM=134° and 139°). Melillo's images on Oct 7 (CM=140°) show the same features. Roussell, Frassati and Melillo continued to observe Mercury during the latter part of the week. Greatest elongation occurred on Sept. 27. On Sept 26, Thomas Williamson's webcam image showed Mercury exactly at half phase.

Apparition 6: (Evening) 25 Oct 25 – 27 Dec

Mario Frassati and Tim Wilson contributed during this apparition. The approaching holiday season and indifferent weather seriously interfered with observation during this period.

(Figure 8) Frassati made the first four drawings from Nov 17 to Dec 9 (CM=324° to CM=70°). It is hard to believe that Solitudo Martis was visible again just south of the equator. But on Dec 8, Frassati drew a large white area where Kuiper crater should be. It is possible he that recorded the Kuiper crater ejecta rays' blanket. On Dec 11, Wilson made a fine drawing (CM=83°) showing Solitudo Martis as a dark and band-like feature in the south.

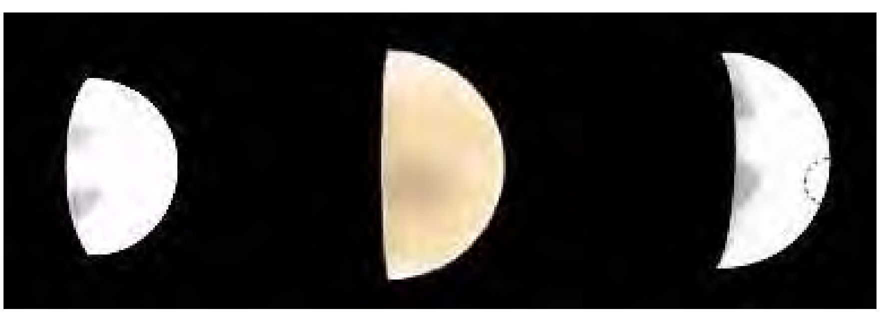

Figure 8 Apparition 6. From left: Drawing by Mario Frassati, 9 Dec 2003, 16:30 UT, CM=70°; Color drawing by Tim Wilson, 11 Dec 2003, 23:30 UT, CM=83°; Drawing by Mario Frassati, 14 Dec 2003, 16:10 UT, CM=97°.

Frassati observed on Dec 14 and 15 (CM=97° and 102°, respectively). Both drawings showed Solitudo Martis just on the terminator south side.

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Feature Story:

ALPO Observations of Venus During the 2001-2002 Western (Morning) Apparition

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Peer review by: *John Westfall*

Abstract

Results of an analysis of photo-visual observations submitted to the ALPO Venus Section by observers in Germany, Italy, Puerto Rico and the United States throughout the 2001-2002 Western (Morning) Apparition are summarized in the report. Data resources and types of telescopes used in making those observations are discussed, and comparative studies deal with observers, instruments, and visual and photographic data. The apparition report includes illustrations and a statistical investigation of the categories of markings in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are also discussed, as well as the status of the continued monitoring of the dark hemisphere of Venus for the Ashen Light.

Introduction

An excellent pool of 132 visual drawings, photographs and CCD images of Venus was submitted to the ALPO Venus Section during the 2001-2002 Western (Morning) Apparition. Geocentric phenomena in Universal Time (UT) for the 2001-2002 Apparition are given in *Table 1*, while *Figure 1* shows the distribution of observations by month during the observing season.

Throughout the 2001-2002 Western (Morning) Apparition, observational coverage of Venus was fairly consistent. The majority of observers started monitoring Venus just two days after Inferior Conjunction (which occurred on 2001 March 30), and they continued to draw or image Venus up to eight days before Superior Conjunction on 2002 January 14. For this they are to be commended! Routine observational coverage of Venus throughout any apparition is always valuable, and continuity in regular surveillance of the planet has become commonplace in recent years. The "observing season," or observation period, ranged from 2001 April 01 to 2002 January 06, and 91.7 percent of the observations occurred between 2001 April and October. During this interval, Venus passed through greatest brilliancy (-4.5m_v), dichotomy, and maximum elongation (45°.8) from the Sun.

Twelve (12) observers contributed visual and photographic data during the 2001-2002 Western (Morning) Apparition of Venus, and *Table 2* lists their observing sites, number of observations, and instruments used.

Figure 2 shows the distribution of observers and submitted observations by nation of origin for the 2001-2002 Western (Morning) Apparition. Three-fourths (75.0 percent) of the individuals participating in the observing programs of the ALPO Venus Section resided in the United States, but these individuals accounted for only slightly more than half (54.5 percent) of the total observations received. Thus, during the 2001-2002 observing season the international

Terminology: Western vs Eastern

"Western" apparitions are those when Venus is **west of the Sun**, as seen in our morning sky before sunrise.

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

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flavor of our programs continued. The ALPO Venus Section is always seeking to facilitate improved global cooperation among lunar and planetary observers interested in the special observing problems presented by the planet Venus and its elusive atmospheric features.

Table 1: Geocentric Phenomena in Universal Time (UT) for the 2001-2002 Western (Morning) Apparition of Venus

Inferior Conjunction	2001	Mar	30^d	04^h UT	
Initial Observation		Apr	01	18	
Greatest Brilliancy		May	04	18	($m_V = -4.5$)
Greatest Elongation West		Jun	08	05	(45°.8)
Dichotomy (predicted)		Jun	08	22.7	
Final Observation	2002	Jan	06	10	
Superior Conjunction		Jan	14	12	
Apparent Diameter (observed range):	59″.63 (2001 Apr 01) ↔ 9″.87 (2002 Jan 06)				
Phase Coefficient, ***k*** (observed range):	0.011 (2001 Apr 01) ↔ 0.999 (2002 Jan 06)				

Table 2: Participants in the ALPO Venus Observing Program During the 2001-2002 Western (Morning) Apparition

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Arnold, Dave. Flagstaff, AZ	5	20.3-cm (8.0-in) SCT
Benton, Julius L. Wilmington Island, GA	28	12.0-cm (4.7-in) REF
Boisclair, Norman J. South Glens Falls, NY	6	9.0-cm (3.5-in) MAK
	1	50.8-cm (20.0-in) NEW
Crandall, Ed. Winston-Salem, NC	3	7.5-cm (3.0-in) REF
Cudnik, Brian. Weimar, TX	3	35.6-cm (14.0-in) CASS
	1	25.4-cm (10.0-in) NEW
del Valle, Daniel. Aquadillo, Puerto Rico	1	20.3-cm (8.0-in) NEW
	26	20.3-cm (8.0-in) SCT
Frassati, Mario. Crescentino, Italy	9	20.3-cm (8.0-in) SCT
Haas, Walter H. Las Cruces, NM	1	31.8-cm (12.5-in) NEW
Melillo, Frank J. Holtsville, NY	11	20.3-cm (8.0-in) SCT
Niechoy, Detlev. Göttingen, Germany	24	20.3-cm (8.0-in) SCT
Schmude, Richard W. Barnesville, GA	12	10.2-cm (4.0-in) REF
Venable, Roger. Wrens, GA	1	40.6-cm (16.0-in) NEW
Total No. of Observers	12	
Total No. of Observations	132	

* CASS = Cassegrain, MAK = Maksutov, NEW = Newtonian, REF = Refractor, SCT = Schmidt-Cassegrain.

The types of instruments used in making observations of Venus in 2001-2002 are shown graphically in *Figure 3*. Also, nearly two-thirds (62.9 percent) of all observations were made with telescopes of 15.2 cm (6.0 in) aperture or greater. For the first time in several apparitions, the number of Schmidt-Cassegrains and Maksutovs in making visual observations and drawings of Venus or capturing CCD images exceeded that of refractors, Newtonians, and Cassegrains (61.4 percent versus 38.6 percent, respectively). During 2001-2002, the majority of observations (87.3 percent) were made under twilight sky conditions, with the remainder (12.8 percent) when the background sky was relatively dark. A considerable number of observers tracked Venus into the daylight sky after sunrise to try to minimize the detrimental effects of glare associated with the planet. This practice also allowed observers to study Venus when it was higher in the sky in order to avoid image degradation and bad seeing near the horizon.

The writer conveys his sincere gratitude to the twelve individuals listed in *Table 2* for all of the excellent drawings, descriptive reports, and CCD images they contributed in 2001-2002. This perseverance by dedicated Venus observers just before and right after sunrise, often an inconvenience for many who must head off to work the same morning, is most appreciated. We encourage readers interested in learning more about Venus and our various observing endeavors to join the ALPO and become regular contributors to the ALPO Venus Section in forthcoming apparitions.

A word about visual observations and making drawings of Venus at the eyepiece is needed. In recent years, there have been increasing numbers of observ-

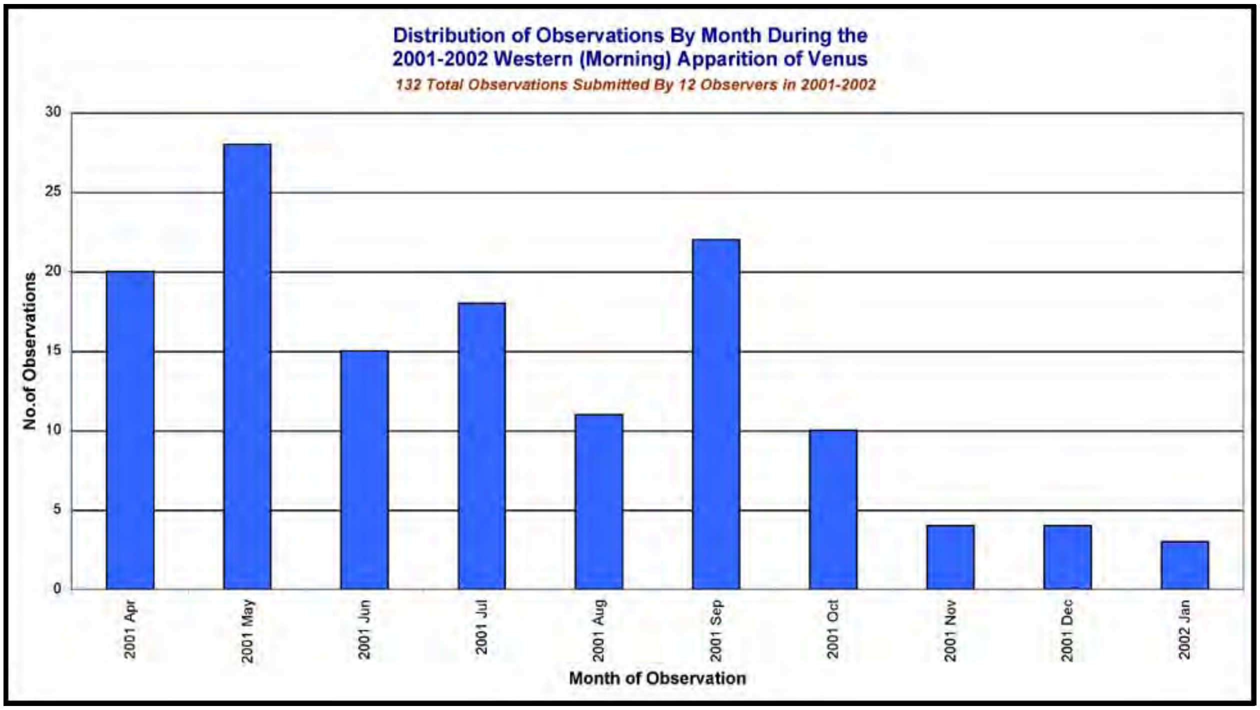

Figure 1. Number of observations submitted by month during the 2001-2002 Western (Morning) Apparition of Venus, with an apparitional total of 132.

ers contributing beautiful, detailed CCD images and photographs of Venus at visual and UV (ultraviolet) wavelengths. We always encourage those who possess CCD, video and digital cameras to image the planet regularly. As valuable as these new high-tech methods are, observers should never forget that there is still a need for well-executed drawings of the planet. An observer with a trained eye, carefully watching and sketching the planet in integrated light (no filter) and with color filters, can take advantage of those intermittent periods of excellent seeing to record detail and subtle contrasts in the atmosphere

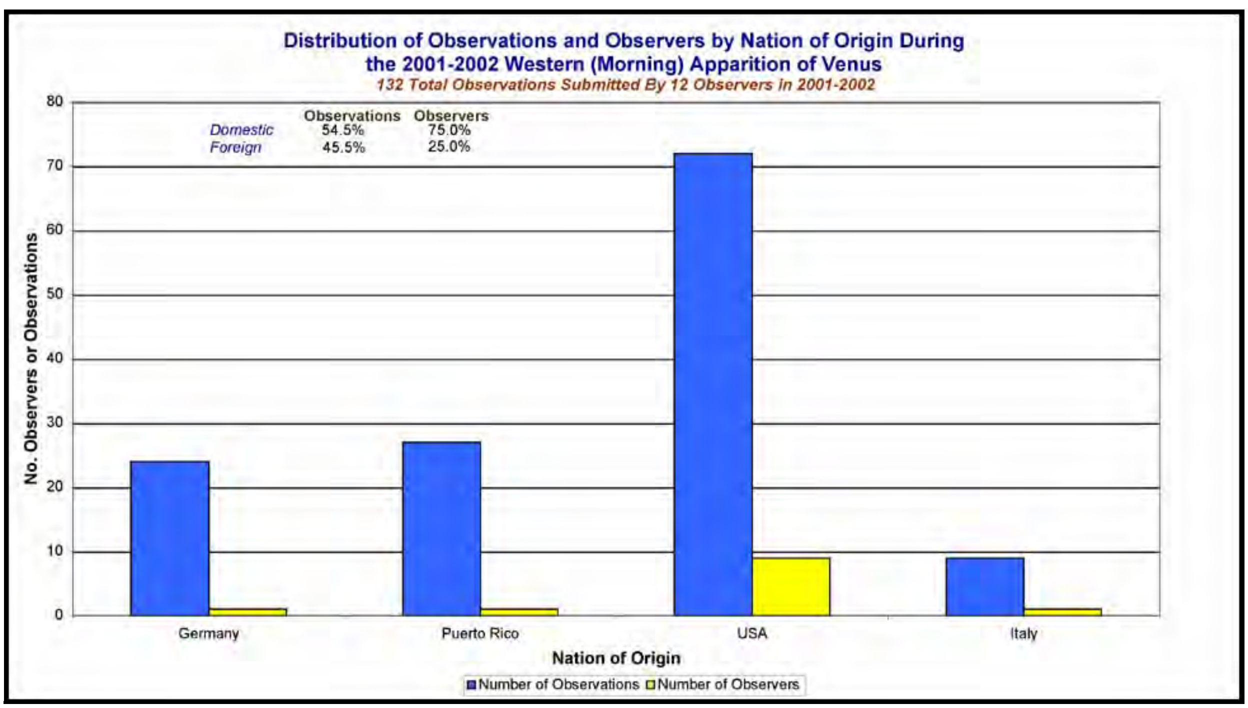

Figure 2. Number of observations and observers by nationality for the 2001-2002 Western (Morning) Apparition of Venus.

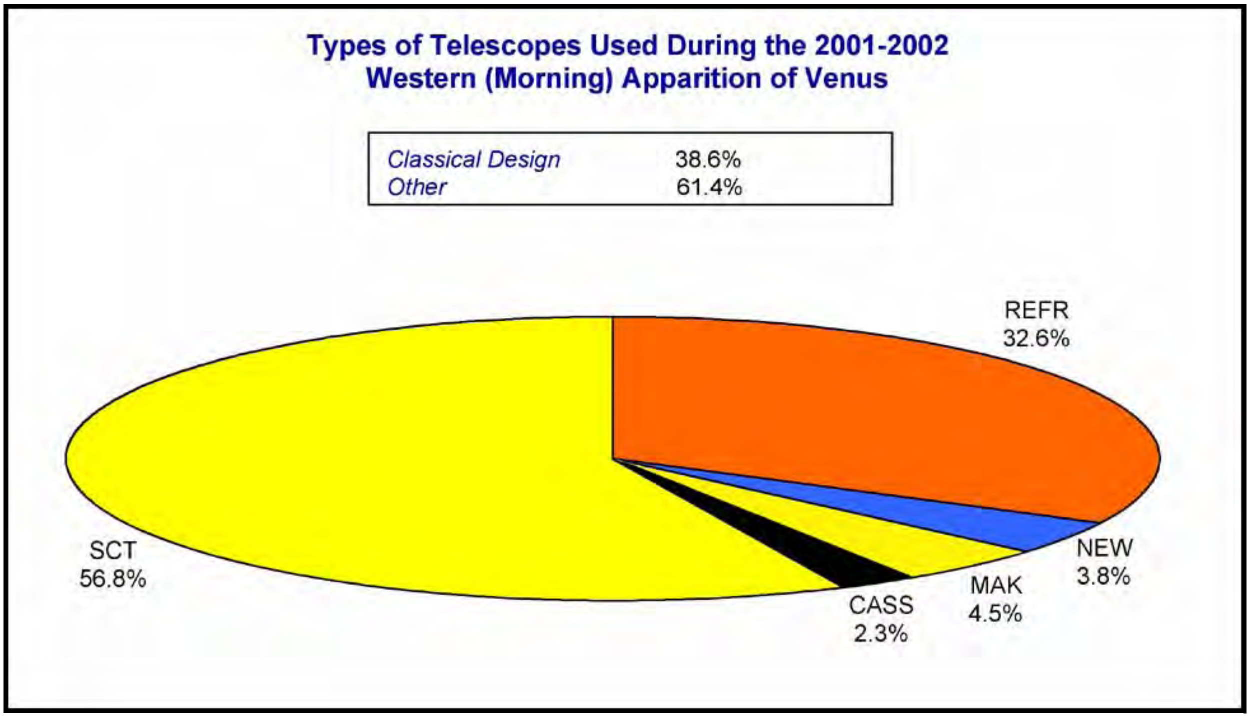

Figure 3. Relative number of telescopes used by type of optical design, 2001-2002 Western (Morning) Apparition of Venus.

of Venus. Of course, visual observations always suffer from some level of subjectivity, and thus we encourage simultaneous observations by visual observers as a means of improving opportunities for confirmation of discrete phenomena. Routine simultaneous visual observations and concurrent CCD imaging add a valuable collaborative dimension to data acquisition.

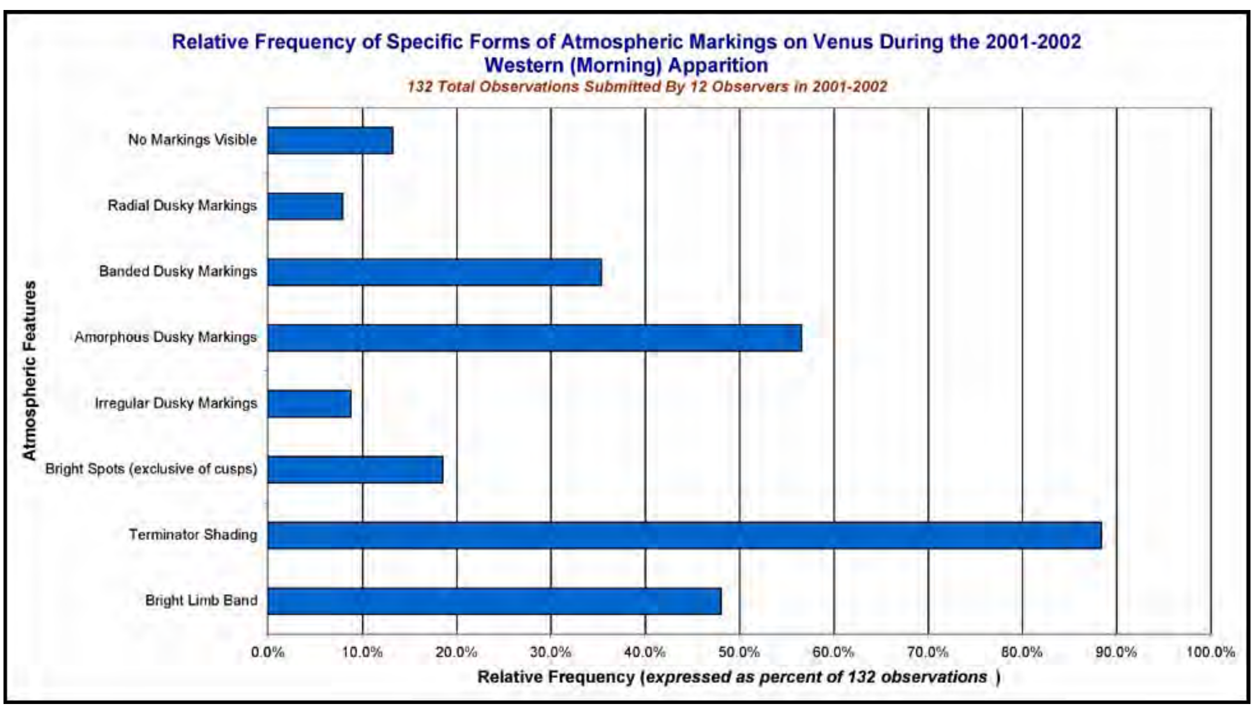

Figure 4. Relative frequency of observations reporting specific forms of atmospheric markings during the 2001-2002 Western (Morning) Apparition of Venus.

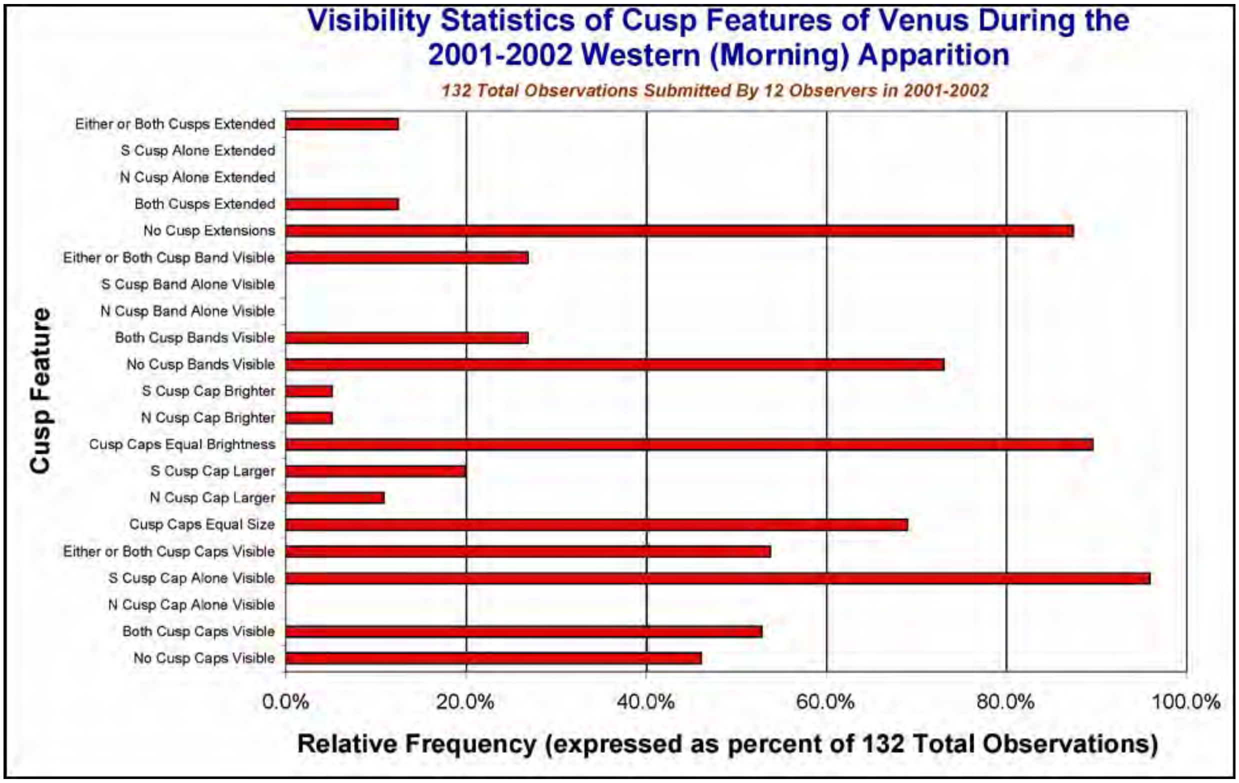

Figure 5. Relative frequency of visibility and aspects of specific types of cusp features, 2001-2002 Western (Morning) Apparition of Venus.

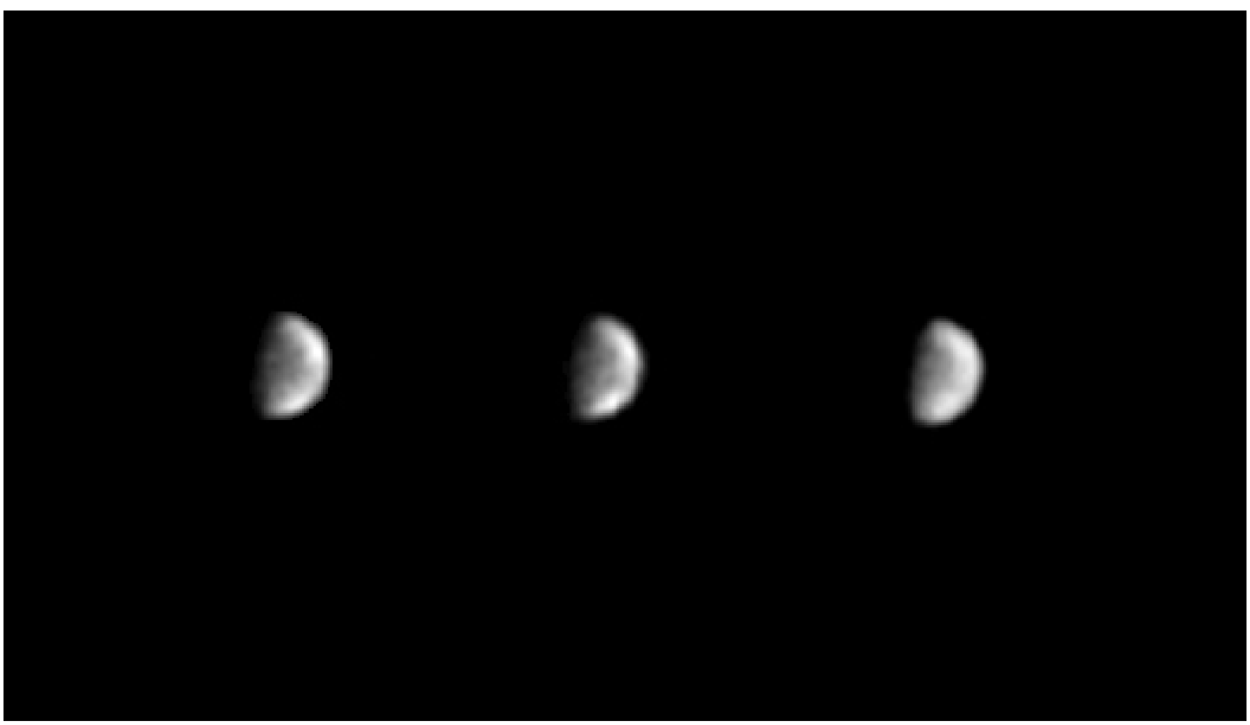

Figure 6. CCD UV (ultraviolet) images of Venus by Frank J. Melillo. 2001 Jul 14d13h45m - 14h15m UT. 20.3-cm (8.0-in) SCT at f/25, Starlight Xpress MX-5 camera, Schott UG-1 UV and IRB (infrared-blocking) Filters. Seeing 9.0 (on the ALPO Scale, ranging from 0 for worst to 10 for perfect). Phase (k) = 0.664, Apparent Diameter = 16".91. South is at the top in Figures 6 - 14, while the contrast of the drawings has been exaggerated for reproduction.

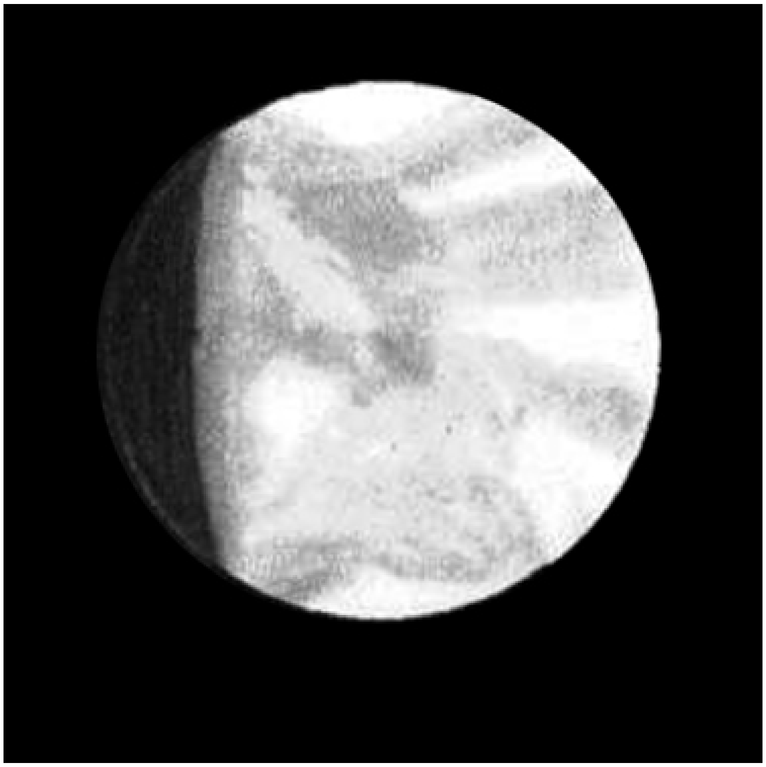

Figure 7. Drawing of Venus by Daniel del Valle. 2001 Sep 01d09h54m - 10h22m UT. 20.3-cm (8.0-in) SCT, 339X; IL (integrated light), W47 (dark blue), W25 (dark red) and W12 (dark yellow) Filters. Seeing 6.0, Twilight. Phase (k) = 0.826, Apparent Diameter = 12".66. Radial dusky markings?

Observations of Venusian Atmospheric Details

The methods and techniques for pursuing observations of the vague and elusive "markings" in the atmosphere of Venus are discussed in detail in the newest edition of *The Venus Handbook*. This guide to observing methods and techniques is now available either as a printed manual or as a pdf file for download. Also, readers who have access to earlier issues of this Journal may find it beneficial to consult the previous apparition reports listed at the end of this paper for a historical perspective on ALPO studies of Venus.

While a significant number of the Venus observations in 2001-2002 used in this analysis were made at visual wavelengths (in integrated light and with color filters), contributor Frank Melillo continued to faithfully contribute his excellent ultraviolet-light CCD images of Venus. Representative drawings and CCD images accompany this report as illustrations.

In examining the photo-visual data for the 2001-2002 Western (Morning) Apparition, the writer found that all of the traditional categories of dusky and bright markings in the atmosphere of Venus were seen or suspected by observers (see the references at the end of this report). *Figure 4* is a graph of the frequency of the specific forms of markings that were reported. Most observations referred to more than one category of marking or feature; consequently, totals exceeding 100 percent are not uncommon. Although gleanings from these data appear reasonable, readers should be aware that considerable subjectivity exists in visual accounts of the notoriously elusive atmospheric markings of Venus. It is probable that this factor affected the data presented in *Figure 4*, and hence, the need for sustained simultaneous visual observing programs.

It should be no surprise to those who have attempted observations of Venus that the dusky markings in the atmosphere of the planet are difficult to detect visually. This is a well-known characteristic of Venus that is largely independent of the experience of the observer, and it is a factor that often frustrates and

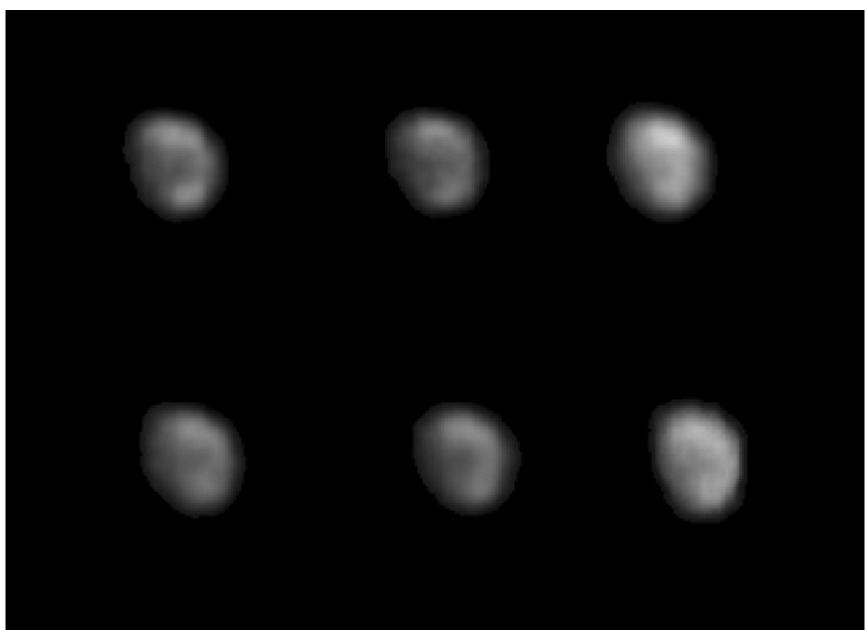

Figure 8. CCD UV Images of Venus by Frank J. Melillo. 2001 Sep 02d14h50m - 15h15m UT. 20.3-cm (8.0-in) SCT at f/25, Starlight Xpress MX-5 camera, Schott UG-1 UV and IRB Filters. Seeing 8.0. Phase (k) = 0.829, Apparent Diameter = 12".60. Radial dusky markings?

discourages the novice. At visual wavelengths, using color filters and variable-density polarizers typically helps improve one's chances of seeing any subtle cloud detail on Venus. The morphology of features revealed at UV wavelengths is typically different from what is seen in visual regions of the spectrum, particularly for the radial dusky patterns. Thus, in addition to purely visual work, the ALPO Venus Section urges observers to attempt UV photography and CCD imaging; some examples of such work by Melillo accompany this report.

Figure 4 shows that 13.3 percent of the observations of Venus in 2001-2002 referred to a brilliant disc completely devoid of markings. When dusky features were seen or suspected, most fell into the categories of "Amorphous Dusky Markings" (56.6 percent), "Banded Dusky Markings" (35.4 percent), "Irregular Dusky Markings" (8.9 percent) and "Radial Dusky Markings" (8.0 percent).

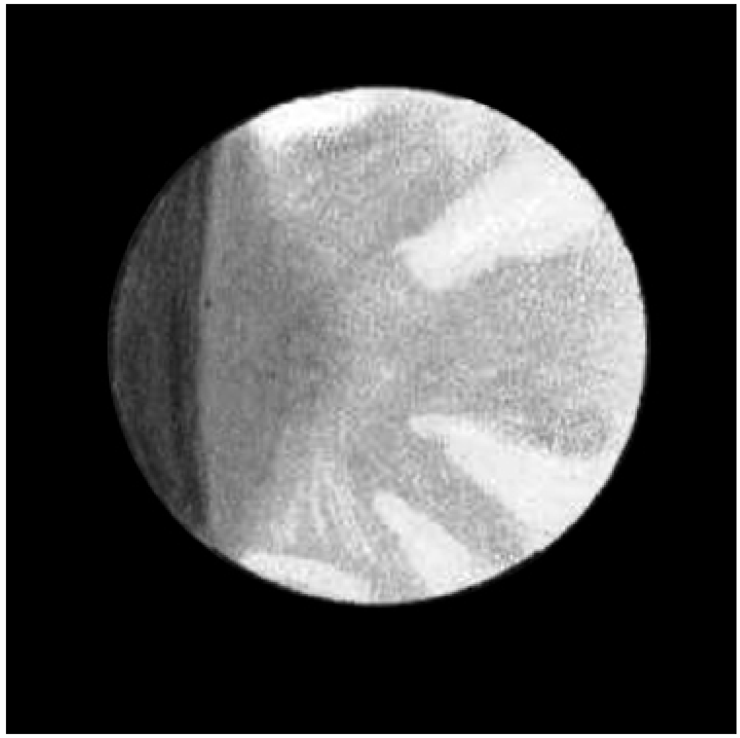

Figure 9. Drawing of Venus by Daniel del Valle. 2001 Sep 03d09h19m - 10h28m UT. 20.3-cm (8.0-in) SCT, 339X; IL, W47 and W12 Filters. Seeing 4.5, Transparency 3.0. Phase (k) = 0.831, Apparent Diameter = 12".55. Radial dusky markings?

Terminator shading was apparent during much of the 2001-2002 observing season, reported in 88.5 percent of the observations, as shown in *Figure 4*. The terminator shading usually extended from one cusp region to the opposite one, and the shading appeared to lighten (i.e., assume a higher intensity) as one progressed from the region of the terminator toward the bright limb of the planet. In most reports, this gradation in brightness ended in the Bright Limb Band. Most of the CCD images by Melillo at UV wavelengths during 2001-2002 showed terminator shading as well.

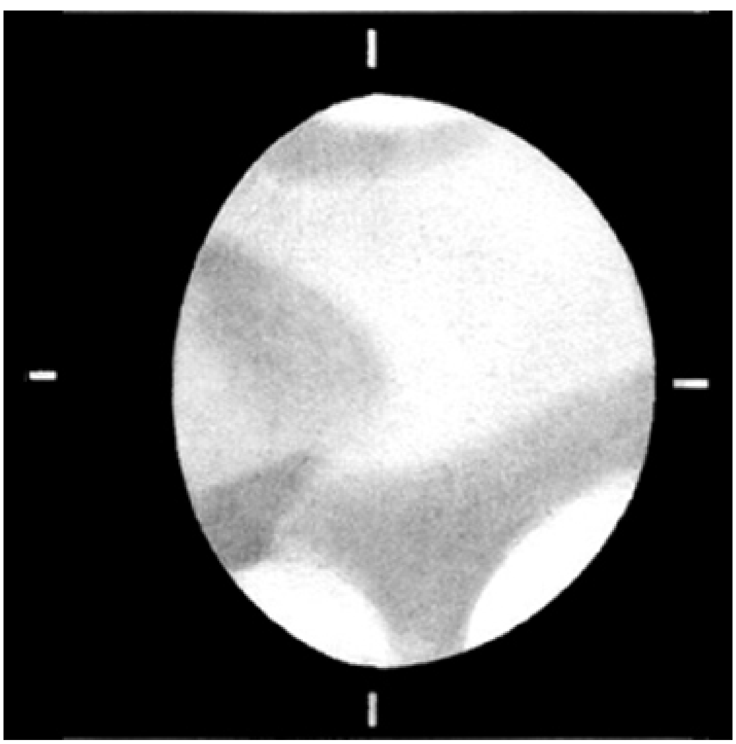

Figure 10. Drawing of Venus by Mario Frassati. 2001 Sep 15d13h05m UT. 20.3-cm (8.0-in) SCT, 250X; IL and W80A (blue) Filter. Seeing 3.0 (interpolated). Phase (k) = 0.863, Apparent Diameter = 11".95.

The mean relative intensity for all of the dusky features on Venus in 2001-2002 ranged from 8.4 to 8.9, in the ALPO Scale of Intensity, which ranges for 0.0 for black to 10.0 for the brightest possible condition. The ALPO Scale of Conspicuousness (which runs sequentially from 0.0 for "definitely not seen" up to 10.0 for "certainly seen") was also used regularly during 2001-2002. On this scale, the dusky markings referred to in *Figure 4* had a mean conspicuousness of approximately 3.5 during the apparition, which suggests that these features fell within the range from very indistinct impressions to somewhat good indications of their actual presence on Venus.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusps, were seen or suspected in 18.6 percent of the submitted observations. It is a routine practice for

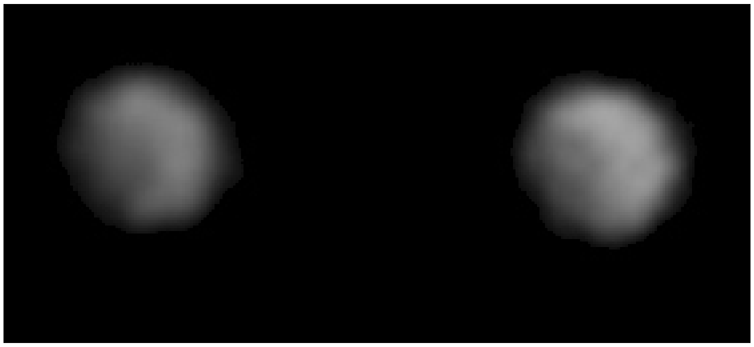

Figure 11. CCD UV Images of Venus by Frank J. Melillo. 2001 Oct 13d14h45m - 15h00m UT. 20.3-cm (8.0-in) SCT at f/20, Starlight Xpress MX-5 camera, Schott UG-1 UV and IRB Filters. Seeing 6.5. Phase (k) = 0.922, Apparent Diameter = 10".94.

observers to call attention to such bright areas by sketching in dotted lines around such features in drawings made at visual wavelengths.

Observers regularly employed color filter techniques during the 2001-2002 Western (Morning) Apparition, and when results were compared with studies in integrated light, it was clear that color filters and variable-density polarizers enhanced the visibility of elusive atmospheric phenomena on Venus.

The Bright Limb Band

Figure 4 shows that nearly half (48.1 percent) of the submitted observations in 2001-2002 described a "Bright Limb Band" on the illuminated hemisphere of Venus. When the Bright Limb Band was reported, it appeared as a continuous, brilliant arc extending from cusp to cusp in 62.0 percent, and interrupted or only partially visible along the limb of Venus in 38.0 percent, of the positive reports. The mean numerical intensity of the Bright Limb Band was 9.9, the feature becoming more obvious when color filters or variable-density polarizers were employed. Despite the dazzling brilliance of this feature to visual observers, it was not readily apparent – or at least noted – on accompanying observing forms by those who included photographs or CCD images of Venus in 2001-2002.

Terminator Irregularities

The terminator is the geometric curve that divides the sunlit and dark hemispheres of Venus. Observers described an irregular or asymmetric terminator in only 23.1 percent of the observations in 2001-2002. Amorphous, banded, and irregular dusky atmospheric markings appeared to blend with the shading along the terminator, possibly contributing to reported deformities. Filter techniques enhanced the visibility of terminator irregularities and dusky atmospheric features closely associated with it during the 2001-2002 Western (Morning) Apparition. Because of irradiation, bright features adjacent to the terminator may occasionally look like bulges, and dark features may look like dusky hollows.

Cusps, Cusp-Caps and Cusp-Bands

In general, when the fraction of the disk that is illuminated, called the *phase coefficient* or **k**, lies between 0.1 and 0.8, features on Venus with the most contrast and prominence are frequently sighted at or near the planet's cusps. These cusp-caps are often bordered by dusky, usually diffuse, cusp-bands.

Figure 5 shows the visibility statistics for Venusian cusp features in 2001-2002. When the northern and southern cusp-caps of Venus were observed in 2001-2002, *Figure 5* illustrates that they were equal in size for 69.1 percent, and equal in brightness in 89.7 percent, of the observations. The northern cusp-cap was considered the larger 10.9 percent of the time and the brighter in 5.2 percent of the time, while the southern cusp-cap was the larger in 20.0 percent of the observations and the brighter 5.2 percent of the time. Nei-

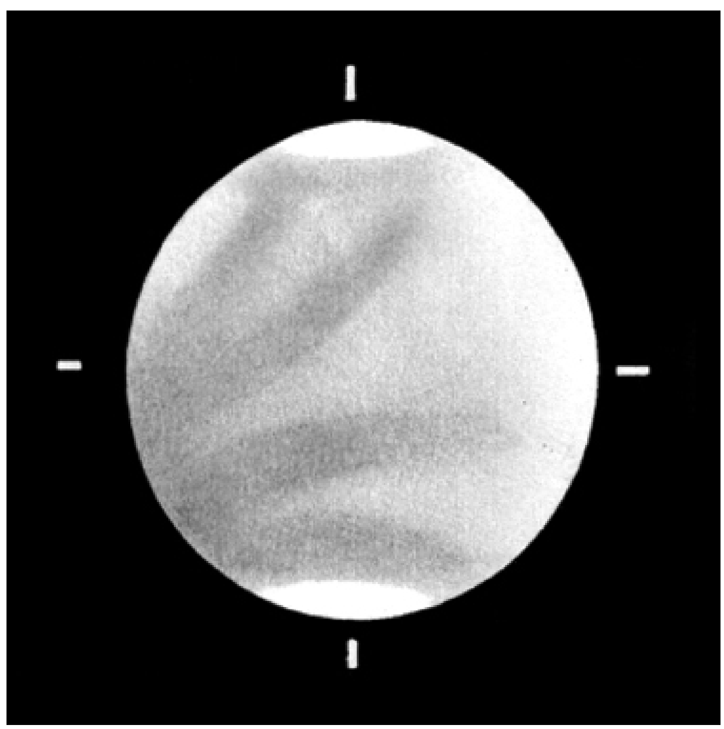

Figure 12. Drawing of Venus by Mario Frassati. 2001 Nov 01d08h08m UT. 20.3-cm (8.0-in) SCT, 250X; IL and W80A Filter. Seeing 2.0 (interpolated). Phase (k) = 0.952, Apparent Diameter = 10".46.

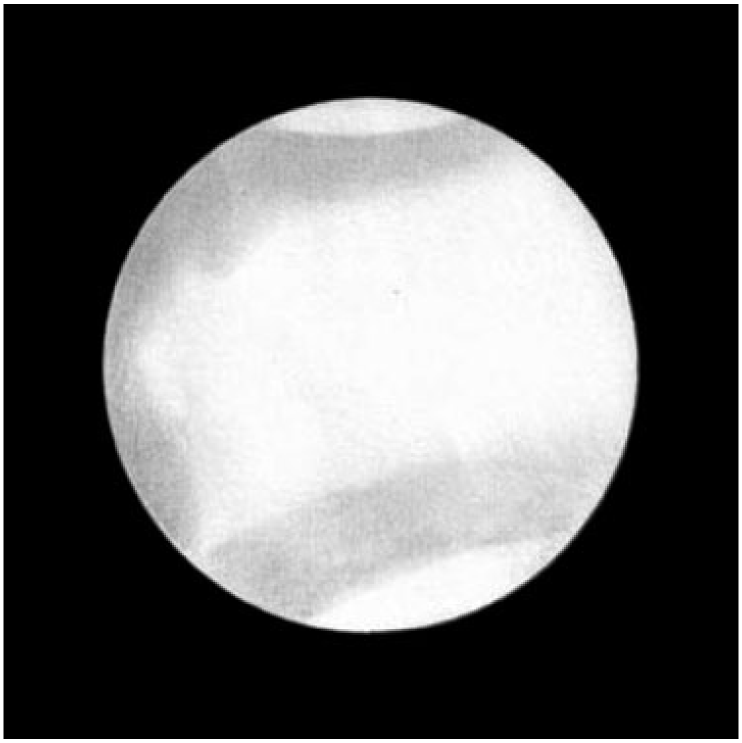

Figure 13. Drawing of Venus by Mario Frassati. 2001 Dec 22d12h48m UT. 20.3-cm (8.0-in) SCT, 160X; W80A Filter. Seeing 4.0 (interpolated). Phase (k) = 0.996, Apparent Diameter = 9".82.

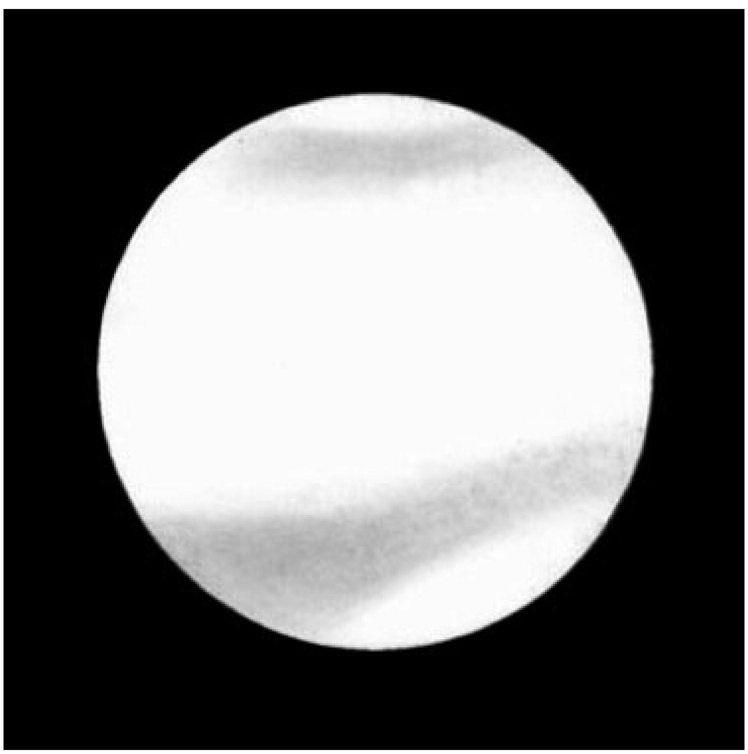

Figure 14. Drawing of Venus by Mario Frassati. 2002 Jan 06d10h30m UT. 20.3-cm (8.0-in) SCT, 133X; W80A Filter. Seeing 4.0 (interpolated). Phase (k) = 0.999, Apparent Diameter = 9".76. When this drawing was made, Venus's elongation from the Sun was only 2°.0.

ther cusp-cap was visible in 46.2 percent of the reports. The mean relative intensity of the cusp-caps was about 9.9 during the 2001-2002 Apparition. Dusky cusp-bands bordering the bright cusp-caps were not reported in 73.1 percent of the observations when cusp-caps were visible, and the cusp-bands displayed a mean relative intensity of about 6.8 (see *Figure 5*).

Cusp Extensions

As shown in *Figure 5*, there were no cusp extensions reported beyond the 180° expected from simple geometry in 87.5 percent of the observations (in integrated light and with color filters). Because the amount of extensions is clearly a function of the phase **k** of Venus, observers should expect an absence of cusp extensions at gibbous phases following dichotomy through the time of Inferior Conjunction. Early in the 2001-2002 Apparition, as Venus progressed through its crescentic phases following inferior conjunction, several observers recorded cusp extensions that ranged from 1° to 45°. In his observation of 2001 April 1, just after inferior conjunction, Haas suspected that the cusps joined along the planet's unilluminated limb, forming a ring of light encircling the whole dark hemisphere of Venus. Cusp extensions were sometimes indicated on drawings, and most observers agreed that color filters and polarizers enhanced their appearance. None of the alleged extensions were photographed or imaged successfully, however, and experience has shown that cusp extensions are very difficult to document on conventional film due to the fact that the sunlit regions of Venus are so much brighter than the faint extensions. Observers are encouraged to try their hand at recording cusp extensions using CCD, digital, and video cameras in future apparitions.

Estimates of Dichotomy

A discrepancy between the predicted and the observed dates of dichotomy (half-phase), known as the "Schröter Effect" on Venus, was not reported by observers during the 2001-2002 Western (Morning) Apparition because no observers submitted phase estimates during the apparition. (The predicted half-phase occurs when $\boldsymbol{k}$ = 0.500, and the phase angle, $\boldsymbol{i}$, between the Sun and the Earth as seen from Venus equals 90°.)

Dark Hemisphere Phenomena and Ashen Light Observations

The Ashen Light, first reported by G. Riccioli in 1643, refers to an extremely elusive, faint illumination of Venus' dark hemisphere. The Ashen Light resembles Earthshine on the dark portion of the Moon, but the latter has a different origin. Most observers agree that Venus must be viewed against a completely dark sky for the Ashen Light to be seen, but such circumstances occur only when the planet is very low in the sky where adverse terrestrial atmospheric conditions contribute to poor seeing. Also, substantial glare in contrast with the surrounding dark sky influences such observations. Even so, the ALPO Venus Section continues to hear from observers who say they have seen the Ashen Light when Venus was observed against a twilight sky.

During 2001-2002, there were no reports of the Ashen Light being seen or suspected in Integrated Light, color filters, or variable-density polarizers. There were also no instances during the 2000-2002 Western (Morning) Apparition when observers described the dark hemisphere of Venus looking *darker* than the background sky, a phenomenon that is sometimes reported and is almost certainly a contrast effect.

Conclusions

The results of our analysis of visual and photographic observations contributed to the ALPO Venus Section during the 2001-2002 Western (Morning) Apparition of Venus suggested only limited activity in the atmosphere of the planet. It has already been noted that it is quite problematic to differentiate between what constitutes real atmospheric phenomena on Venus at visual wavelengths and what is merely illusory. The level of confidence in our results will improve as observers make an effort to do simultaneous observations, and the ALPO Venus Section stresses combined visual observations and CCD imaging for comparative analysis. There is also a definite need for more ultraviolet imaging of Venus simultaneously with visual observations; for example, some observers apparently have a slight visual sensitivity in the near UV range, whereby they report radial dusky features that are so readily apparent on UV photographs and images.

ALPO studies of the Ashen Light, which peaked during the Pioneer Venus Orbiter Project, are still continuing during every apparition. Constant monitoring of the planet for the presence of this phenomenon by a large number of observers, ideally participating in a simultaneous observing program, remains important as a means of improving our chances of capturing confirmed dark-hemisphere events. Imaging with CCD and digital cameras to attempt to capture the faint glow on the dark hemisphere at crescentic phases is an important endeavor that must continue.

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

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Feature Story:

Galilean Satellite Eclipse Timings: The 1995/97 Apparition

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Online Readers

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•In the References section at the end of this paper, left-click your mouse on the *blue text* to be taken to an Internet site where you can either view or obtain that particular work.

Abstract

The ALPO Jupiter Section received 343 visual timings of the eclipses of Jupiter's Galilean satellites Io, Europa, Ganymede and Callisto from 26 observers for the 1995/97 Apparition. For each satellite, eclipse visual disappearance and reappearance timings were adjusted for telescope aperture and were then compared with the Jet Propulsion Laboratory's "E-2" Ephemeris. None of the four satellites differed significantly in position from the E-2 Ephemeris.

Introduction

The 1995/97 Apparition of Jupiter was the 20th analyzed by the ALPO Jupiter Section's Galilean Satellite Eclipse Timing Program. The satellites timed were Io (1), Europa (2), Ganymede (3) and Callisto (4). Visual observers timed the "first speck" visible when the satellite emerged from Jupiter's shadow (reappearance), or the "last speck" seen when the satellite entered the shadow (disappearance). Reports for previous apparitions are listed under References (at the end of this paper). [Westfall 1983-84, 1986a, 1986b, 1987, 1988, 1989, 1991, 1992, 1994, 1996, 1998, 1999 and 2000]

Table 1 lists some important dates for the 1995/97 Jupiter Apparition. All dates and times in this report are in Universal Time (UT). Note that an *apparition* is the period between successive solar conjunctions, while an *observing* season is the period of actual observation. Thus the 1995/97 observing season began only 34 days after solar conjunction, with Jupiter 26° west of the Sun; it ended 45 days before the next conjunction, at solar elongation 36° east.

At its closest approach to us, Jupiter's distance was 4.18608 AU [astronomical units; 1 AU = 149,597,870 km], with an apparent equatorial diameter of 47".03. At opposition, Jupiter had a visual magnitude of -2.2 and a geocentric declination of -21°.9 so that observers in the Earth's Southern Hemisphere were favored over those in the Northern Hemisphere for this apparition.

Observations

The 343 timings received for 1995/97 bring our 20-apparition total to 8,994 visual timings, but represent a 16-percent drop from the 1994/95 Apparition. A total of 26 persons made observations and are listed in **Table 2** along with their nationalities, telescope apertures and number of timings. The timings themselves are given in **Table 8**, with the observers and their telescope apertures identified by the numbers given in the left-hand column of **Table 2**.

Timings for the 1995/97 Apparition were made by observers in seven countries in four continents, and the number of observers and timings received from each nation are given in **Table 3**. There continue gaps in longitude in our coverage, including Asia and much of the Pacific Basin. Also, it is disappointing that under one-quarter of the observers were from the United States and that they averaged relatively few timings per observer.

Contributing to this total were 262 timings (76 percent) by 14 New Zealand and Australian observers coordinated by Brian Loader of the Royal Astronom-

Table 1: 1995/97 Jupiter Apparition Chronology (Meeus 1995; U.S. Naval Observatory 1994, 1995 and 1996. Dates and times are UT.)

Conjunction with the Sun	1995 DEC 18, 22h
First Eclipse Timing	1996 JAN 21, 21h
Callisto Eclipse Series Begins	1996 MAR 09, 16h
Opposition to the Sun	1996 JUL 04, 12h
Closest Approach to Earth	1996 JUL 05, 18h
Last Eclipse Timing	1996 DEC 05, 13h
Conjunction with the Sun	1997 JAN 19, 13h

Table 2: Participating Observers, Galilean Satellite Eclipse Timings, 1995/97 Apparition

Ob. No.	Observer	Nationality	Teles. Aper. (cm)	Number of Timings
1	Abrahams, W.	Australia	6	1
2	Allely, T.	New Zealand	10.2	2
3	Bembrick, C.	Australia	7	24
3a	" "	"	25	14
4	Blanksby, J.	Australia	15	25
5	Bock, P.	USA (VA)	12.7	2
6	Bulder, H.	Netherlands	30	4
7	Busa, S.	Hungary	20	7
8	Dickie, R.	New Zealand	20	7
8a	" "	" "	25	13
9	Hays, R.	USA (IL)	15	12
10	Kruijshoop, A.	Australia	20	10
11	Larkin, P.	Australia	20	27
12	Laskowski, S.	USA (WI)	31.8	5
13	Loader, B.	New Zealand	20	31
14	Mac Donald, M.	New Zealand	30	33
15	MacDougal, C.	USA (FL)	15	4
16	Maluf, W.	Brazil	6	5
16a	" "	"	7	1
16b	" "	"	15	4
17	Moller, H.	Australia	20	22
18	Nyàri, S.	Hungary	5.7	1
18a	" "	"	6	2
18b	" "	"	11.4	1
19	Samolyk, G.	USA (WI)	25	1
19a	" "	" "	32	4
20	Skilton, P.	Australia	15	8
21	Smith, C.	Australia	25	19
22	Stubbings, R.	Australia	25	7
23	Sullivan, M.	Canada	11.43	12
24	Szabó, S.	Hungary	4.8	1
24a	" "	"	6.3	1
24b	" "	"	10.8	1
24c	" "	"	16	1
25	Westfall, J.	USA (CA)	28	9
25a	" "	" "	36	3
26	Wolf, G.	New Zealand	18	19

ical Society of New Zealand. As Jupiter has moved farther south, the Australia-New Zealand observers' contribution has become increasingly significant. Sadly, no new observers joined the program and 19 of the 1994/95 observers did not submit timings for 1995/97. On the other hand, the 1995/97 observers averaged 13.2 timings per observer, up from 9.0 in 1994/95, with the 20-apparition mean just 8.2 timings per observer per apparition. We wish here to recognize those observers for the 1995/97 Apparition who had contributed observations for five or more apparitions. **Table 4** gives their names, number of apparitions and number of timings.

Telescope aperture definitely affects timing results. Also, most observers used a single telescope, but seven used two or more instruments. The most popular aperture continues to be 20 cm, with a median of 16 cm; both values typical for recent apparitions. Eight small telescopes, of 4.8- to 7-cm aperture, were used. At the other extreme, there were only five fairly large telescopes, of 30 to 36-cm aperture. The range of apertures continues to be large, showing that almost any size of telescope can be used in our program.

Table 5 gives the number of timings by satellite and type of event. As always, eclipses of the satellites closer to Jupiter are timed more frequently because their orbital periods are less than those of satellites farther from the planet and their eclipses thus more frequent. As with all previous apparitions, there is a bias toward reappearance timings; in this case the bias was smaller than usual, with just 52 percent of the timed events being reappearances.

The outermost Galilean satellite, Callisto, is a special case because for roughly three years at a time it passes north or south of Jupiter's shadow, experiencing no eclipse. Between these eclipseless periods, the satellite undergoes approximately three years of eclipses, with its "eclipse season" commencing and ending with one or more partial eclipses. Callisto's partial eclipse of 1996 MAR 09 marked the beginning of an eclipse season which ran to 1998 NOV 23.

As is usual, the number of timings varied by month, as shown in **Table 6**. The most frequent observing was for the months nearest opposition (1996 JUL 04), when Jupiter was above the horizon for most of the night. It is interesting that the time distribution of timings was bimodal, with one peak in May and another in August. The August peak is easy to understand because of the convenience of observing a planet in

Table 3: Observers and Timings by Nationality, Galilean Satellite Eclipse Timings, 1995/97 Apparition

Nationality	Number of Observers	Number of Timings	Timings per Observer
Australia	9	157	17.4
Brazil	1	10	10.0
Canada	1	12	12.0
Hungary	3	15	5.0
Netherlands	1	4	4.0
New Zealand	5	105	21.0
USA	6	40	6.7
Total	26	343	13.19

the evening sky after opposition, but the weaker peak in May is harder to explain. (Editor's note: This may be because the events occurred close to the glare of Jupiter during opposition). Also, there is the usual bias toward post-opposition timings, which in this apparition constituted 59 percent of the timings. It would be helpful if observers could make more pre-opposition timings in the future, even though this means observing after midnight.

Naturally, the pattern of the different eclipse phenomena for the different satellites affects the frequency of observations. Eclipse disappearances of Io are visible only before opposition, and its reappearances visible only after. This is usually true for Europa as well; but when Jupiter is near aphelion, as in 1995, both the disappearance and reappearance events of the same eclipse can be seen near quadrature. On the other hand, disappearances and reappearances for the same eclipses of Ganymede and Callisto can be observed for most of an apparition except near opposition or conjunction.

Table 4: Long-Term Participating Observers, Galilean Satellite Eclipse Timing Program (through 1995/97 Apparition)

Observer	Number of Apparitions	Number of Timings
William Abrahams	11	47
Colin Bembrick	10	135
J.L. Blanksby	9	245
Paul H. Bock	8	43
Henk J.J. Bulder	10	104
Ross Dickie	7	97
Robert Hays	10	113
Alfred Kruijshoop	10	165
Patricia Larkin	7	203
Brian Loader	15	330
Malcolm Mac Donald	9	153
Craig MacDougal	11	119
Harry Moller	8	291
Gerry Samolyk	6	22
Peter Skilton	5	75
Charlie Smith	9	187
Sandor Szabó	5	26
John Westfall	19	352

Reduction

Reduction began by grouping the timings by satellite and also by whether they were of a disappearance or a reappearance. The reported times were compared with the predictions of the "E-2" Ephemeris developed by Jay H. Lieske of the Jet Propulsion Laboratory. [Lieske, 1981] The predicted time of each event was then subtracted from the observed time; a positive observed-minus-computed difference meant that an event was "late"; a negative (O-C) difference, that it was "early." We expect disappearances to be late, and reappearances early, in relation to the predicted eclipse time because the latter predicts the time when, as seen from the center of the satellite's disk, the Sun is bisected by the limb of Jupiter. One would then expect the satellite to be at one-half its uneclipsed brightness, but in actuality, albedo differences and limb darkening misplace the optical (brightness) center of the satellite from the geometric center of its disk. [Mallama *et al*., 2000] The (O-C) differences are given in the right-hand column in **Table 8**. The next step was to correct for aperture with a linear regression model in which the dependent variable (y) was the (O-C) difference in seconds and the independent variable (x) was the reciprocal of the telescope aperture in centimeters. The form of the model is:

(1) $y_{est} = A + Bx$

where A and B are the regression coefficients.

A total of 36 timings, or 11 percent, were not used because they differed from the regression model at the 5-percent significance level (i.e., could occur by chance less than 5 percent of the time) as measured by the standard error (given in **Table 7**). For each satellite and type of event this 5-percent significance criterion was applied twice in succession. The timings not used for the 1995/97 Apparition are shown by italicized residuals in **Table 8**. It is evident that timings near the beginning and end of the apparition are often unsatisfactory because the event has to be observed in twilight, near the horizon, or both. Another unfortunate situation occurs near

Table 5: Number of Galilean Satellite Eclipse Timings by Event Type, 1995/97 Apparition

Satellite	(1) Io	(2) Europa	(3) Ganymede	(4) Callisto	Total
Disappearances	73	35	32	22	162
Reappearances	82	57	22	18	179
Partial Eclipse				2	2
Total	155	92	54	42	343

opposition, when eclipse events occur near the glare of Jupiter's limb.

Two statistics describe how well Equation (1) fits the observed residuals. One, the standard error (S.E.), is the root-mean-square difference between Equation (1) and each observation. The other statistic, the coefficient of variation or R^2, measures what proportion of the variance (squared differences among the residuals) is removed by Equation (1).

1995/97 Results

Results for the 1995/97 Apparition are given in **Table 7**, while **Figure 1** illustrates the "Disappearance" and "Reappearance" locations of the Galilean satellites as viewing the objects from above.

Table 7 gives results for each of the four satellites in a separate column. Each column is divided into three parts, "Disappearance," "Reappearance" and "Orbital Residual." For both disappearances and reappearances, the number of timings made is given first, followed in parentheses by the number finally used in the regression analysis after aberrant timings have been deleted. The next entry is the mean (O-C) difference for the timings that were retained, along with its 1-standard error uncertainty range; in **Table 7** all such uncertainty ranges are preceded by the "±" symbol. The next row contains the coefficient of variation (R^2). If the latter is followed by "(ns)" the coefficient is not significantly different from zero and thus there is no significant aperture effect; if by "*" the chance of a false aperture effect being due to chance is 5 percent or less; if R^2 is followed by "**" the probability of a chance effect is under 1 percent. In the "A(sec)" and "B(sec-cm)" rows the two regression coefficients are given with their 1-standard error uncertainty ranges. Next is the standard error of estimate for the regression model. Following this are the predicted (O-C) differences for four commonly used telescope apertures.

The last three rows of Table 7 give the orbital residual, which measures the amount the satellite is "behind" (positive) or "ahead of" (negative) its predicted position, in seconds, kilometers, and degrees of orbital arc, with the standard error and statistical significance of the time residual. In order to find a satellite's orbital residual it is necessary to have performed a regression analysis on observations of both its eclipse disappearance and reappearance. For this reason, and because a significant number of timings is needed, the orbital residuals listed in Table 7 should be considered as averages for the entire observing season; they give no information on possible short-term (within-apparition) deviations of a satellite from its predicted position. That such weeks- or months-scale deviations occur is indicated by photometric CCD timings. [Mallama *et al.*, 2000]

There are eight event types listed in **Table 7**; eclipse disappearances and reappearances for each of the four satellites. As shown by the R^2 values, in five of the eight cases, the aperture-regression model significantly reduced the variance among the timings. Nonetheless, in none of the eight regressions was the majority of the variance among the timings accounted for in our simple residual-aperture model. Naturally, the uncertainties in our timings represent the combined effect of many variables that are not considered in our analysis; for example: type of instrument, magnification, optical quality, atmo-

Table 6: Number of Galilean Satellite Eclipse Timings by Month, 1995/97 Apparition

Month 1996	Solar Elongation Range (observing season only)	Number of Timings
JAN	026-034°W	2
FEB	034-058°W	9
MAR	058-085°W	20
APR	085-112°W	32
MAY	112-143°W	41
JUN	143-175°W	35
JUL	175°W-153°E	35
AUG	153-120°E	72
SEP	120-091°E	39
OCT	091-065°E	49
NOV	065-040°E	8
DEC	040-036°E	1
	Before Opposition	142 (41%)
	After Opposition	201 (59%)

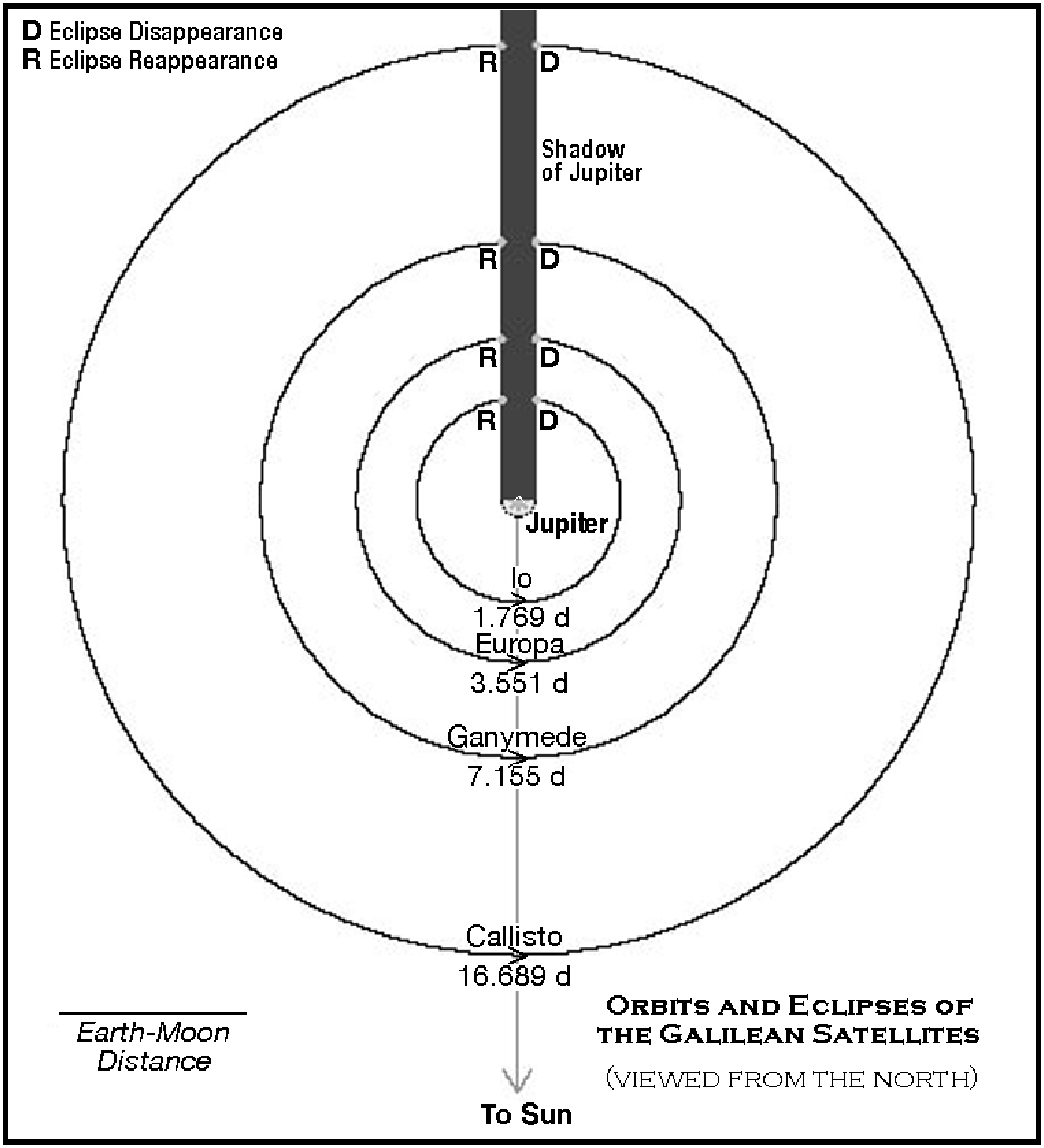

Figure 1. Illustration of relative positions of Jupiter and its Galilean satellites with respect to Eclipse Disappearance and Eclipse Reappearance when viewing Jovian system from above. Illustration provided by J. Westfall.

spheric conditions, distance and phase angle of Jupiter, apparent distance of the satellite from Jupiter's limb, keenness of the observer's eye, or possible use of an occulting bar (an object placed at the focus of a positive eyepiece to block out Jupiter itself). Clearly, only some of these variables are quantifiable, and for some we have no data at all. Nonetheless, with the large number of timings which have accumulated since 1975, a more complex statistical analysis is possible, which might reduce the amount of uncertainty.

The standard error gives the uncertainty of the timings, which increased with distance from Jupiter as follows (standard errors are given as disappearance/reappearance):

- 14/16 seconds for Io
- 25/22 seconds for Europa
- 47/58 seconds for Ganymede
- 84/92 seconds for Callisto

This trend of uncertainties increasing with satellite distance from Jupiter is expected as the satellites move more slowly, and Jupiter's shadow penumbra becomes broader, with increasing distance from the planet. Also, except for Europa, the standard errors are slightly greater for eclipse reappearances than for disappearances, reflecting the uncertainty in reappearances of viewing the exact position where the "first speck" will appear.

The values of the B-coefficients indicate the effect of telescope aperture on the observed time of "first speck" or "last speck." With the exception of the eclipse disappearances of Europa, the values follow the expected pattern:

(i) B is negative for disappearances and positive for reappearances. "Last speck" occurs after, and "first speck" before, the predicted time.

(ii) The larger the aperture, the later a disappearance, or the earlier a reappearance, is judged to occur.

(iii) The absolute value of the B-coefficient tends to increase with a satellite's distance from Jupiter; as orbital semimajor axis increases, a satellite's orbital velocity decreases and the width of the penumbral band of Jupiter's shadow increases.

Table 7: Galilean Satellite Eclipse Timing Differences from E-2 Ephemeris, 1995/97 Apparition

	Satellite			
	(1) Io	**(2) Europa**	**(3) Ganymede**	**(4) Callisto**
Disappearance				
Number of Timings	73 (64)	35 (33)	32 (28)	22 (19)
Mean Difference (sec)	+84.2 ± 1.8	+115.3 ± 4.4	+269.1 ± 11.3	+438.8 ± 20.2
Regression Coefficients				
R^2	0.1056**	0.0717 (ns)	0.4122**	0.1478 (ns)
A (sec)	+95.7 ± 4.6	+103.7 ± 8.6	+333.9 ± 17.6	+498.5 ± 39.7
B (sec-cm)	-215 ± 79	+188 ± 121	-1026 ± 240	-989 ± 576
Standard Error (sec)	± 14.1	±24.6	±46.7	±83.6
Aperture Differences (sec)				
6 cm	+60 ± 9	+135 ± 13	+163 ± 27	+334 ± 64
10 cm	+74 ± 4	+122 ± 6	+231 ± 12	+400 ± 30
20 cm	+85 ± 2	+113 ± 5	+283 ± 9	+449 ± 20
40 cm	+90 ± 3	+108 ± 6	+308 ± 13	+474 ± 28
Reappearance				
Number of Timings	82 (73)	57 (52)	22 (20)	18 (16)
Mean Difference (sec)	-84.6 ± 2.0	-94.2 ± 3.2	-237.1 ± 14.8	-378.2 ± 23.5
Regression Coefficients				
R^2	0.1473**	0.1174*	0.2802*	0.1120 (ns)
A (sec)	-95.5 ± 3.6	-108.3 ± 6.2	-302.7 ± 27.9	-436.9 ± 49.8
B (sec-cm)	+153 ± 44	+234 ± 91	+990 ± 374	+924 ± 696
Standard Error (sec)	±15.9	±22.0	±57.6	±91.9
Aperture Differences (sec)				
6 cm	-70 ± 5	-69 ± 10	-138 ± 40	-283 ± 75
10 cm	-80 ± 2	-85 ± 5	-204 ± 18	-344 ± 34
20 cm	-88 ± 2	-97 ± 3	-253 ± 14	-391 ± 25
40 cm	-92 ± 3	-102 ± 4	-278 ± 20	-414 ± 35
Orbital Residual				
Seconds	+0.1 ± 2.9 (ns)	+3.5 ± 3.8 (ns)	+15.6 ± 16.5 (ns)	+30.8 ± 31.8 (ns)
Orbital Arc (degrees)	+0.000 ± .007	+0.004 ± 0.004	+0.009 ± 0.010	+0.008 ± 0.008
Kilometers	+2 ± 51	+48 ± 52	+170 ± 179	+253 ± 261

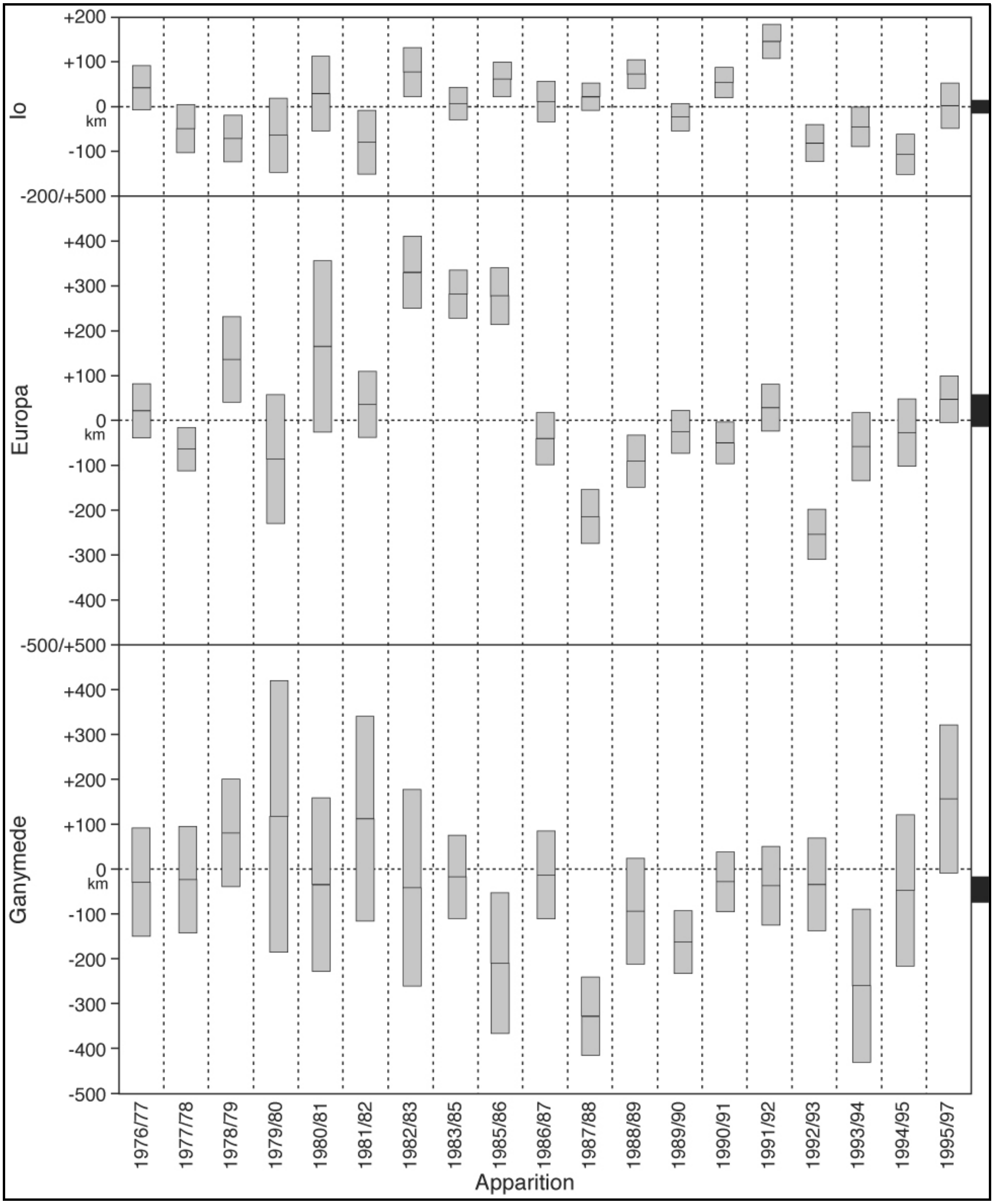

Figure 2. Deviations in kilometers of the Galilean satellites Io, Europa and Ganymede from the JPL E-2 Ephemeris for the 1976/77 – 1995/97 Apparitions of Jupiter. The black line in the center of the grey bar for each apparition represents the estimated deviation of each satellite, while the bar itself shows the 1-sigma uncertainty range. The black rectangle on the right margin of the graph shows the 1-sigma range of the 19-apparition mean deviation; none of these three long-term means are significantly different from 0 at the 5-percent significance level. (Callisto is not shown on the graph because it undergoes eclipses in only about half the apparitions.)

The orbital residuals, expressed in seconds of time, are the simple means of the disappearance and reappearance A-coefficients of each satellite, except for Europa, where the R^2 value for disappearances was not statistically significant, and its B-coefficient had the wrong sign. Thus, for Europa, the orbital residual was estimated by finding the mean of the mean of the disappearance timings and the A-coefficient of the reappearance timings. The four satellites' time residuals have also been converted to degrees of orbital arc and to kilometers. The timing results differed significantly from the E-2 Ephemeris for none of the four satellites.

Long-Term Results

The apparent changes in satellite position between the 1994/95 and 1995/97 apparitions were found by subtracting the former from the latter, giving:

Io +6.2±3.9 s

Europa +5.5±6.6 s

Ganymede +20.0±22.6 s

None of these apparent changes is statistically significant; there was no "acceleration" or "deceleration" of any satellite between this apparition and the one immediately previous.

Considering the entire history of our program, the orbital residuals for Io, Europa, and Ganymede for the 19 apparitions from 1976/77 (there were insufficient observations for the 1975/76 Apparition to determine its orbital deviations) through 1995/97 are graphed in Figure 2. The graph does not include Callisto because of the intermittent nature of its eclipses. In the figure, the error bars represent a 1 standard-error range, and a deviation from the ephemeris significant at the 5-percent level would have to equal at least about 2 standard errors.

The diagram hints at cyclical variations for some of the satellites, particularly Europa and Ganymede, perhaps in a 12-year cycle reflecting Jupiter's orbital period. We hope that sufficient timings for enough future apparitions will reveal such long-term patterns in the residuals.

Conclusion

We encourage suitably-equipped observers to use CCD cameras to time the eclipses of Jupiter's four major satellites and then to report their results to the program headed by Anthony Mallama. He advises using a telescope of at least 5 inches (12.7 cm) aperture with a mounting that gives high-precision tracking, giving an image scale of one arc second or less per pixel, with a time source accurate to at least 0.2 seconds, using a filter with a Johnson V bandpass. He can supply data-reduction Windows 98 software for the PC Lynxx, Meade 416, and SBIG ST-7, ST-8 and ST-10 cameras. [E-mail to anthony_mallama-at-raytheon.com ; see also his references below]; note that conventional aperture photometers are difficult to use accurately because of the effect of scattered light from Jupiter.

We also need to continue the visual timings which remain the mainstay of our program and provide comparability with the body of many thousand similar visual timings that goes back to the 17th Century.

We hope that present participants will continue and new ones will join us. For information on the visual timing program, please contact the writer, whose address is given in the ALPO staff listing in this Journal, ALPO and on the ALPO website. He can send you instructions, with a timing report form which should be returned at the end of each apparition (not the calendar year). You will also need predictions of these events, which are published each year in the *Astronomical Almanac*, the *Observer's Handbook* of the Royal Astronomical Society of Canada, and the *Handbook* of the British Astronomical Association, as well as every month in *Sky & Telescope* magazine.

We thank the many observers who participated in this ALPO project for the 1995/97 Apparition of Jupiter. Remember that your timings become more accurate as you accumulate experience, and also that the more visual timings that are made, the more accurate our results.

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This Month's Cover

Saturn with Tethys and Enceladus; north is at top. Image taken November 19, 2005, 20:06 UT by Christopher Go. Location: Cebu City, Phillipines. LRGB image with brightness and contrast adjusted slightly to enhance visibility of both Saturnian moons near their name labels and a luminance layer added to smooth the image. Image data: 20-second exposure using a Celestron C-11 Schmidt-Cassegrain telescope on an AP900GTO mount; scope equipped with a DMK21BF04 FireWire monochrome camera using the IC Capture 2.0 driver, and image processing done with Registax 3.0. RGB was done using a Homeyer Filter wheel. No other image details available. Source: *http://saturn.cstoneind.com/*

Table 8: Galilean Satellite Eclipse Timings, 1995/97 Apparition

UT Date (mmdd)	Limb. Dist. (R_J)	Latitude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)
Io Disappearances					
1996 0121	0.6	-13°	17	222	*+31*
0130	0.6	-13	26	101	*+48*
0213	0.8	-13	17	012	+87
0222	0.8	-13	4	020	+53
0229	0.9	-13	11	011	+73
0309	1.0	-13	4	201	+54
			11	000	+74
			20	100	+81
0316	1.0	-13	14	001	+91
0323	1.0	-12	20	000	+104
			11	000	+105
0330	1.1	-12	17	011	+89
0401	1.1	-12	21	021	+82
0408	1.1	-12	26	111	+74
			17	011	+78
			3a	000	+103
0410	1.1	-12	13	200	+94
0415	1.1	-12	21	122	+98
			11	000	+104
0417	1.1	-12	13	000	+57
			21	210	+87
			26	011	*+117*
0422	1.0	-12	17	010	+88
0424	1.0	-12	11	020	+73
			8	110	+89
			14	000	+89
0426	1.0	-12	8a	201	+83
0501	1.0	-12	4	021	+61
			14	000	+68
			11	010	+82
			13	000	+92
			10	000	+113
0503	1.0	-12	13	000	+93
0508	0.9	-12	4	101	+68
			3a	000	+105
0510	0.9	-12	3	000	+59
			22	220	+74
			17	210	+85
			14	000	+89
			21	101	+105
0517	0.8	-11	4	000	+76
			3a	100	+93
			13	000	+98
			26	100	*+139*
Io Disappearances — Continued					
1996 0519	0.8	-11°	14	020	*+7*
			26	110	+72
0522	0.8	-11	7	101	+78
0524	0.7	-11	3	000	+77
			26	001	+81
			21	100	+106
0526	0.7	-11	14	000	+76
0531	0.6	-11	3a	000	+98
0602	0.6	-11	14	000	+75
			4	002	+82
			13	000	+95
			22	000	+100
0607	0.5	-11	7	010	+87
0609	0.5	-11	3a	000	+94
			13	000	+99
			26	010	+102
0611	0.5	-11	3a	100	+83
0613	0.4	-11	9	110	+84
			15	211	+95
0616	0.4	-11	26	110	+96
0618	0.3	-11	3	000	+61
			14	000	+62
			26	010	+103
0620	0.3	-11	23	110	*+115*
0622	0.3	-11	24c	112	*+41*
0625	0.2	-11	11	120	*+32*
0627	0.1	-11	8a	101	+57
			26	010	*+129*
0702	0.0	-10	11	002	+64
Io Reappearances					
0706	0.0	-10°	25a	100	-50
			8	100	*+37*
			14	020	*+226*
0709	0.1	-10	7	112	-79
0711	0.1	-10	17	021	*+4*
0713	0.2	-10	13	000	-100
			8	200	-52
0720	0.3	-10	8a	020	*-32*
0722	0.4	-10	23	100	-78
0727	0.5	-10	17	112	-84
			14	000	*-4*
0729	0.5	-10	23	112	-88
0731	0.5	-10	9	100	-98
			19a	111	-51

Table 8: Continued

UT Date (mmdd)	Limb. Dist. (R_J)	Latitude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)	UT Date (mmdd)	Limb. Dist. (R_J)	Lattude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)
Io Reappearances — Continued						**Io Reappearances — Continued**					
1996 0801	0.6	-10°	24a	110	-84	1996 1001	1.1	-8°	12	211	-93
0803	0.6	-10	3	000	-81				19a	112	-79
0805	0.6	-10	10	000	-110	1008	1.1	-8	25	100	-103
			13	000	-100	1009	1.1	-8	16a	000	-69
			3	000	-84	1013	1.1	-8	21	101	-104
			8a	110	-78				3	000	-85
0807	0.7	-10	23	111	-76				13	120	-80
			9	100	-94				20	010	-80
0808	0.7	-10	24b	120	-67	1015	1.1	-8	25	220	-85
0810	0.7	-10	3	100	-71	1016	1.1	-8	16b	000	-81
0812	0.7	-10	21	101	-110				5	000	-70
			13	000	-97	1020	1.1	-8	11	000	-98
			3	000	-82				4	000	-92
			8a	100	-79				3	000	-61
			14	002	*-31*	1027	1.0	-8	17	112	-77
0814	0.8	-10	13	001	-102	1029	1.0	-8	8a	200	-96
0819	0.8	-9	21	210	-99				3	000	-75
0821	0.9	-9	3	000	-79				4	002	-59
0823	0.9	-9	15	101	-108	1031	1.0	-8	25	100	-91
			16	000	*+31*				23	110	-50
0828	0.9	-9	21	102	-112	1105	1.0	-8	10	000	-104
			1	001	-88				11	000	-93
			3	000	-86				4	120	-75
			14	000	-82				3a	010	*-33*
0830	1.0	-9	25	100	-99	1121	0.8	-7	3a	000	-84
			9	100	-98	1205	0.6	-7	17	211	*-31*
			12	211	-92	**Europa Disappearances**					
0904	1.0	-9	21	100	-109	0225	1.4	-18°	4	100	+85
			11	000	-96				11	000	+85
			3	000	-85				17	220	+109
0906	1.0	-9	25	100	-93	0328	1.7	-17	4	100	+102
0908	1.0	-9	12	222	-73				11	010	+126
			16	000	-35	0408	1.7	-17	9	000	+137
0909	1.0	-9	6	100	-108	0415	1.7	-16	26	011	+95
0913	1.1	-9	21	101	-110	0422	1.7	-16	26	011	+97
0915	1.1	-9	16	000	-45				13	010	+123
0920	1.1	-9	8a	101	-96				4	000	+126
			13	010	-96				10	000	+145
0922	1.1	-9	25	100	-58				14	000	+153
0923	1.1	-9	16b	000	-69	0429	1.6	-16	17	111	+116
0927	1.1	-9	8	201	-96				4	000	+119
			4	101	-84				11	010	+121

Table 8: Continued

UT Date (mmdd)	Limb. Dist. (R_J)	Latitude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)	UT Date (mmdd)	Limb. Dist. (R_J)	Latitude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)
Europa Disappearances — Continued						**Europa Reappearances — Continued**					
1996 0503	1.6	-16°	15	101	+129	1996 0814	1.2	-11°	22	000	-109
0510	1.5	-16	14	010	+87				4	010	-100
			15	211	+132				13	020	-96
0517	1.4	-15	4	100	+100				14	000	-60
			14	000	+102	0818	1.3	-11	16	000	-45
			3a	000	+125	0821	1.4	-11	3	000	-80
			22	220	+128	0825	1.5	-11	19a	112	-116
			26	100	+130				23	001	-112
			13	000	+136				9	000	-101
0524	1.2	-15	3	000	+97	0901	1.5	-10	25a	200	-111
0531	1.0	-15	3a	000	+135	0908	1.7	-10	8a	120	-130
0604	1.0	-15	25	201	+108				21	100	-117
0607	0.9	-14	3a	000	+113				13	000	-103
0618	0.5	-14	14	000	*+47*				3	010	-51
			3	100	+78	0915	1.7	-10	21	101	-114
			26	010	+98				13	100	-112
			8	100	+99				10	210	-103
0622	0.4	-14	24	111	+199				14	000	-47
0702	0.1	-13	4	001	*+45*				8a	120	*-7*
			11	002	+70	0919	1.7	-10	9	000	-116
Europa Reappearances						0922	1.8	-10	11	010	-109
0706	0.1	-13°	11	020	-95				17	010	-66
			8	100	*+23*	0929	1.8	-9	7	100	-101
			14	020	*+100*				18a	210	-56
0709	0.2	-13	7	111	-61	1010	1.8	-9	21	111	-112
0713	0.3	-12	13	000	-94				3a	000	-97
			10	120	-85				11	001	-94
			8	100	-81				4	021	-92
0720	0.5	-12	8a	000	-84				14	000	-88
0724	0.7	-12	9	100	-103	1017	1.7	-8	10	000	-149
			19a	211	*-2*				4	000	-119
0731	0.9	-12	13	000	-109				14	000	*-15*
			23	112	-87	1021	1.7	-8	5	101	-85
			14	000	-51	1024	1.7	-8	17	011	-88
0807	1.1	-11	22	000	-108	1028	1.6	-8	25	100	-96
			2	100	-106	1111	1.4	-7	13	220	-46
			11	000	-101	**Ganymede Disappearances**					
			8a	100	-97	0215	1.9	-37°	17	012	+290
			3	000	-93	0322	2.6	-36	11	000	+317
			14	000	-78				20	000	+320
0814	1.2	-11	21	101	-128				4	000	+324
			10	100	-118				10	000	+349

Table 8: Continued

UT Date (mmdd)	Limb. Dist. (R_J)	Latitude	Ob-server No.	Cond. (STB)	(O-C) Dif. (sec)	UT Date (mmdd)	Limb. Dist. (R_J)	Lati-tude	Ob-server No.	Cond. (STB)	(O-C) Dif. (sec)
Ganymede Disappearances — Contd.						**Ganymede Reappearances — Contd.**					
1996 0329	2.7	-35°	17	010	+316	1996 0813	1.9	-27°	23	002	-228
0420	2.6	-34	15	001	+329				16	000	-39
0427	2.5	-33	11	000	+327	0820	2.1	-27	21	102	-283
			13	100	+328				4	002	-203
0519	2.0	-32	18	010	+148	0827	2.3	-26	3	010	-215
0602	1.5	-31	14	000	+246				14	000	-139
0609	1.2	-31	26	011	*+105*	0910	2.6	-25	6	000	-278
			14	000	+257	1009	2.8	-23	13	200	-256
			13	100	+316				14	000	-140
			3a	000	+320	1031	2.5	-22	9	000	-242
0616	0.9	-30	26	100	*+78*	**Callisto Disappearances**					
0813	0.2	-27	16b	222	+138	0428	4.2	-63°	17	010	*+749*
0820	0.4	-26	23	220	+253	0515	3.6	-59	26	100	*+79*
0827	0.6	-26	13	100	+271				17	211	+630
0903	0.8	-25	3	010	+204	0601	2.6	-56	9	000	*+711*
			21	100	+302	0721	0.2	-47	11	000	+385
0917	1.0	-24	6	200	+279	0807	1.5	-45	11	010	+345
0925	1.0	-24	9	000	+263				3	000	+353
			12	201	+286				14	000	+473
1002	1.1	-23	25	100	+291				2	101	+506
1009	1.0	-23	13	010	+260				8a	100	+524
1016	1.0	-23	4	200	+192				22	000	+567
			17	011	+244	0824	2.5	-42	9	000	+477
1023	0.9	-22	7	110	*+137*				12	212	+495
			18a	--1	+140				19	111	+502
1121	0.2	-20	3a	001	*+89*	0909	3.1	-40	6	120	+408
			13	200	+224	0926	3.4	-38	11	000	+389
Ganymede Reappearances						1013	3.3	-35	3	000	+289
0201	0.0	-39°	26	101	*+122*				14	000	+307
0208	0.2	-38	17	221	*-110*				13	100	+397
0315	1.0	-36	21	220	-324				20	000	+434
0322	1.1	-36	11	001	-279				21	120	+445
			20	001	-274	1030	2.8	-33	23	210	+412
			17	011	-270	**Callisto Reappearances**					
0427	1.0	-34	22	000	-299	0515	2.6	-59°	4	020	-478
			4	000	-284				26	100	*+162*
			13	020	-250	0618	0.2	-53	25	100	-294
0708	0.2	-29	23	010	-245	0721	1.4	-48	4	110	-425
0729	1.3	-28	18b	001	-232				11	020	-310
0805	1.5	-27	16b	000	-262	0807	2.0	-48	13	000	-529

Table 8: Continued)

UT Date (mmdd)	Limb. Dist. (R_J)	Lattude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)	UT Date (mmdd)	Limb. Dist. (R_J)	Lattude	Observer No.	Cond. (STB)	(O-C) Dif. (sec)
Callisto Reappearances — Continued						**Callisto Reappearances — Continued**					
1996 0807	2.0	-48°	8a	100	-497	1996 0926	4.9	-38°	7	210	-340
			17	011	-436	1013	4.8	-35	23	020	-356
			11	010	-420				3	000	-166
			3	010	-360	1030	4.4	-33	14	000	-279
			14	000	-315	**Callisto — Partial Eclipse**					
0824	3.9	-43	13	020	-455	0309	3.4/3.8	-78	10	100	-14*
			23	000	-391				20	000	+14*
			14	020	*-84*	*Observed eclipse midpoint relative to E-2 prediction.					

Key to Table 8:

UT Date -- the year, month number and day of the event in Universal Time.

Limb Distance -- The apparent distance of the satellite from the adjacent Jovian limb in units of the Jovian equatorial semidiameter (R_J).

Latitude -- The jovicentric latitude, as projected onto Jupiter's shadow, of the center of the satellite relative to the shadow center.
Observer Number -- Observer number as listed in the first column of Table 2.

Conditions (STB) -- Conditions of observation; seeing (S), transparency (T) and field brightness (B). 0 -- condition not perceptible with no effect on timing, 1 -- condition perceptible with possible minor effect on timing, 2 -- condition serious with definite effect on timing accuracy. (A dash indicates that the observer did not report that particular condition.)

(O-C) Difference -- The time difference in seconds, found by subtracting the eclipse UT predicted by the E-2 Ephemeris from the observed eclipse UT. The E-2 Ephemeris used Ephemeris Time, which was converted to UT using a ΔT value of +62 seconds. Italicized differences denote timings that were not used in the regression analysis because they differed from the regression model at the 5-percent significance level.

What Galileo Saw

Probably the most significant contribution that Galileo Galilei made to science was the discovery of the four satellites around Jupiter that are now named in his honor. Galileo first observed the moons of Jupiter on January 7, 1610 through a homemade telescope. He originally thought he saw three stars near Jupiter, strung out in a line through the planet. The next evening, these stars seemed to have moved the wrong way, which caught his attention. Galileo continued to observe the stars and Jupiter for the next week. On January 11, a fourth star (which would later turn out to be Ganymede) appeared. After a week, Galileo had observed that the four stars never left the vicinity of Jupiter and appeared to be carried along with the planet, and that they changed their position with respect to each other and Jupiter. Finally, Galileo determined that what he was observing were not stars, but planetary bodies that were in orbit around Jupiter. This discovery provided evidence in support of the Copernican system and showed that everything did not revolve around the Earth.

Source: *http://www2.jpl.nasa.gov/galileo/ganymede/discovery.html*

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- **Monograph Number 1.** *Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993.77* pages. Price: $12 for the United States, Canada, and Mexico; $16 elsewhere.
- **Monograph Number 2**. *Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994.52* pages. Price: *$7.50* for the United States, Canada, and Mexico; $11 elsewhere.
- **Monograph Number 3**. *H.P. Wilkins 300-inch Moon Map*. 3rd Edition (1951), reduced to 50 inches diameter; 25 sections, 4 special charts; also 14 selected areas at 219 inches to the lunar diameter. Price: $28 for the United States, Canada, and Mexico; $40 elsewhere.
- **Monograph Number 4.** *Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.127* pages. Price: $17 for the United States, Canada, and Mexico; $26 elsewhere.
- **Monograph Number 5.** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.* By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Price: $10 for the United States, Canada, and Mexico; $15 elsewhere.
- **Monograph Number 6.** *Proceedings of the 47th Convention of the Association of Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.20* pages. Price $3 for the United States, Canada, and Mexico; $4 elsewhere.
- **Monograph Number 7.** *Proceedings of the 48th Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76* pages. Price:

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$12 for the United States, Canada, and Mexico; $16 elsewhere.

- **Monograph Number 8**. *Proceedings of the 49th Convention of the Association of Lunar and Planetary Observers. Atlanta, Georgia, July 9-11,1998.122* pages. Price: $17 for the United States, Canada, and Mexico; $26 elsewhere.
- **Monograph Number 9**. *Does Anything Ever Happen on the Moon?* By Walter H. Haas. Reprint of 1942 article. 54 pages. Price: $6 for the United States, Canada, and Mexico; $8 elsewhere.
- **Monograph Number 10.** *Observing and Understanding Uranus, Neptune and Pluto*. By Richard W. Schmude, Jr. 31 pages. Price: $4 for the United States, Canada, and Mexico; $5 elsewhere.

ALPO Observing Section Publications

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

- **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 harryjam@hotmail.com or 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@astronomical-league.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.ari-

ALPO Resources (continued)

zona.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. 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 8564l-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 50):
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THE ASSOCIATION OF LUNAR AND 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 email 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 (Acrobat Reader) version is available over the internet at reduced cost. Subscription rates and terms are listed below.

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