ISSN-0039-2502

# Journal of the Association of Lunar & Planetary Observers

*The Strolling Astronomer*

**Volume 47, Number 2, Spring 2005**

**Now in Portable Document Format (PDF) for MacIntosh and PC-Compatible Computers**

Founded in 1947

## *Inside. . .*

* Why are we here? (Not mankind, silly. The ALPO.) Answer: Because Walter Haas fought the prevailing belief that amateurs could contribute very little good to astronomy. *Astronomy* magazine profiles our fearless leader.

* ALCon 2005 looms even closer, and we issue a call for ALPO papers.

* Build a Hossfield Pyramid and see the Sun.

* POW! Another meteoroid hits the Moon! And you can see it happen.

* A dome near crater Turner – Can you find it?

* Apparition reports: Jupiter in 1990-91, and the remote planets in 2003.

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

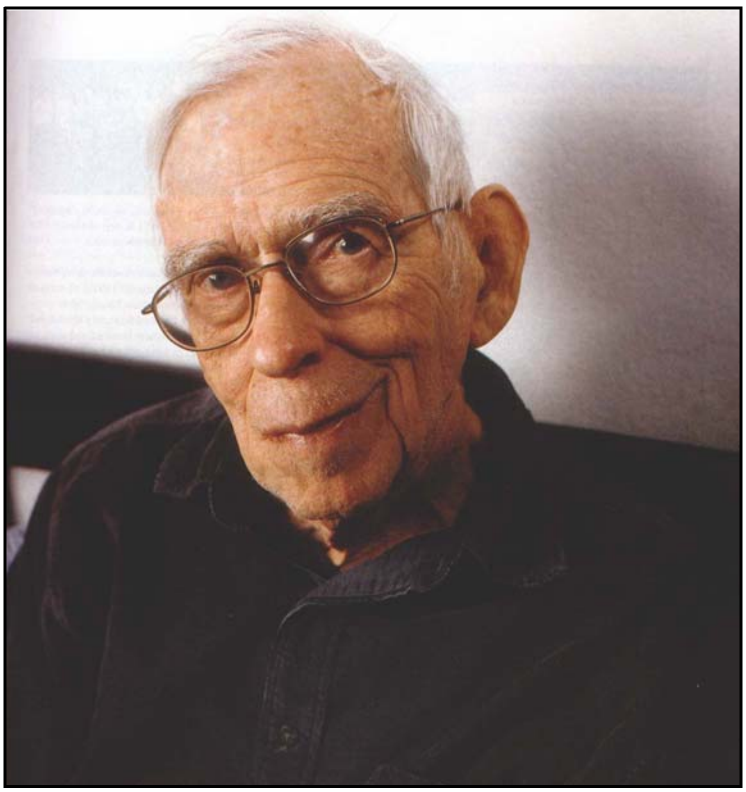

Photo by Christ Chavez, christchavez@hotmail.com

ALPO Founder and Director Emeritus Walter H. Haas

# Journal of the Association of Lunar & Planetary Observers, The Strolling Astronomer

Volume 47, No. 2, Spring 2005
This issue published in June 2005 for distribution in both portable document format (pdf) and also hardcopy format.

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

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



**For membership or general information about the ALPO, contact:**

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

E-mail to: will008@attglobal.net

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

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## Feature Stories



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# *Member, section and activity news*

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### *Board of Directors*

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### *Publications*

Publisher & Editor-in-Chief, Ken Poshedly

### *Primary Observing Section & Interest Section Staff*

(See full listing in *ALPO Resources* at end of issue)
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*Selected Areas Program;* Julius L. Benton, Jr.
*Lunar Transient Phenomena;* Anthony Cook
*Lunar Meteoritic Impact Search;* Brian Cudnik
Acting Coordinator, *Lunar Topographical Studies*; William Dembowski
Acting Coordinator, *Lunar Dome Survey*; Marvin W. Huddleston
**Mars Section:** Daniel M. Troiani
**Minor Planets Section:** Frederick Pilcher
**Jupiter Section:** Richard W. Schmude, Jr.
**Saturn Section:** Julius L. Benton, Jr.
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**Youth Section:** Timothy J. Robertson
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**Instruments Section**: R.B. Minton
**Eclipse Section**: Michael D. Reynolds
**Webmaster:** Richard Hill

## *Point of View*
# *Opposition, elongation, apparition – suggested better nomenclature*

*By Walter H. Haas, ALPO director emeritus*

At approximate 26-month intervals, we hear from astronomers planning "to observe the opposition of Mars". Now we learn from textbooks that opposition is a momentary geometric configuration when the right ascension of the Sun and a superior planet differ by 180 degrees. It is true enough that Mars is closest to the Earth near the time of opposition, and perhaps the popular statement has some validity if our observations are limited to a month or two centered near the date of geometric opposition.

Yet in what was a fairly routine observing season for the Red Planet, the members of the Association of Lunar & Planetary Observers made the first observation on 1992 Apr 24, continued through opposition on 1993 Jan 07, and finally obtained the last observation on 1993 Nov 14. Surely they were not observing the opposition eight months and more from its occurrence! Many other examples could be given.

I recommend that we improve our terminology by doing what some planetary observers have been doing for years, namely, defining the apparition (meaning the "appearance") of a planet as that interval of time during which it can be observed. The period for observing an inferior planet should similarly be called an apparition, not an eastern or western elongation as is often done. The apparition of a superior planet then extends from a conjunction with the Sun to the immediately following conjunction, with an included opposition.

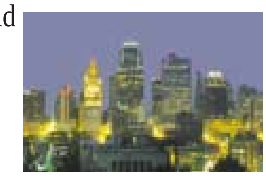
In a similar way an eastern or evening apparition of Mercury or Venus extends from a superior conjunction with the Sun to the next

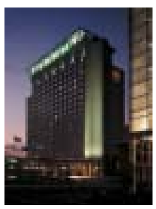
Continued on page 11 (Nomenclature)

ALCON EXPO 2005

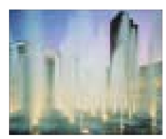
KANSAS CITY OVERLAND PARK AUGUST 12-13, 2005

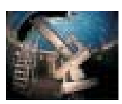
The Astronomical League is proud to announce the 2005 annual convention to be held in Kansas City, August 12-13, 2005.





The League's **Council meeting** will be held August 11 at the National Office, our first council meeting at the facility. There will also be an astronomical trade show and vendor exposition, a **Star-B-Q** at **Powell Observatory**, and a private exhibition at the **Linda Hall Library** where you can hold a Galileo first edition and read Herschel's journal. Our goal will be to increase participation by astronomers and companies and to make this the best trade show we've ever hosted. The meetings, annual awards banquet, trade show, and speakers will all be held at the Overland Park, Kansas, **Sheraton Hotel and Convention Center**. For information about the hotel, call 913-234-2100, or toll free 866-837-4214. Be sure to mention the Astronomical League for a discount rate. For additional information, contact Mr. Carroll Iorg, 7241 Jarboe Street, Kansas City, MO 64114. Phone 816-444-4878 or e-mail Carroll at: Carroll-Iorg@kc.rr.com.





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

## News of General Interest

### Call for ALPO Papers: ALCon 2005

All members of this fine organization are urged to consider submitting a paper on the topic of their choice as it relates to interests of the Assn. of Lunar & Planetary Observers for presentation at this year's Astronomical League Conference (ALCon Expo 2005) to be held August 12-13 in Kansas City.

Presentation of ALPO papers will be concurrent with the other ALCon Expo 2005 activities, but all ALCon registrants are free to attend any of the ALPO sessions.

Please seriously consider this opportunity to showcase your interests and results of your studies.

E-mail the title of your proposed talk along with a short description to ALPO Executive Director Richard Schmude at schmude@gdn.edu as soon as possible so that AL President Bob Gent can be notified in a timely manner.

Final arrangements are being made now for ALCon Expo 2005. The League's Council meeting will be held August 11 at the National Office. This will be the first-ever council meeting at the AL's newly opened national office.

The meetings, annual awards banquet, trade show, and speakers will all be held at the Overland Park, Kansas Sheraton Hotel and Convention Center. For information about the hotel call, 913-234-2100. Be sure to mention the Astronomical League for a discount rate and call toll free at 866-837-4214.

More details are available on the Web at http://www.alconexpo.org/AlconExpo/index.html

Or, contact Mr. Carroll Iorg, 7241 Jarboe Street, Kansas City, MO 64114. Phone 816-444-4878, e-mail is Carroll-Iorg@kc.rr.com

### 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.

### 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.

## ALPO Interest Section Reports

### *Computing Section*

**By Kim Hay, coordinator**

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

The ALPOCS listserv is located at: http://groups.yahoo.com/group/alpocs/ To subscribe, send a message to: alpocs-subscribe@yahoogroups.com.

## Inside the ALPO

# Member, section and activity news *(continued)*

PROFILE

Walter Haas bridged the gap between amateur and professional astronomers when he founded the Association of Lunar and Planetary Observers in 1947. /// BY TRUDY E. BELL

# A planetary pioneer

Walter Haas has observed the Moon and planets for more than 7 decades. But it's what he did away from the eyepiece that's left an indelible mark on astronomy. More than a half century ago, he founded the Association of Lunar and Planetary Observers (ALPO), which coordinates amateur observations of solar-system objects. What began as an informal network of shared data is, today, a worldwide organization uniting amateur and professional astronomers. And it all goes back to an incredible gift.

In 1934, amateur astronomer John H. Chase offered 17-year-old Haas, a budding amateur astronomer in New Waterford, Ohio, an extraordinary choice: an entire year of college free or 8 weeks in Jamaica to work with renowned lunar and planetary observer William H. Pickering.

Which did he choose?

"Being young and foolish — a year at college would have been of far greater economic value — I chose Jamaica," Haas recalls. The following May, he was on a banana boat plying through the deep blue Caribbean toward the British West Indies.

WHILE A STUDENT at Mount Union College in Alliance, Ohio, Walter Haas honed his observing skills and studied the solar system in earnest. He spent countless hours peering through the 10-inch Saegmuller refractor in the school's Clarke Observatory, seen here in its original 1923 building.

### Tropical apprenticeship

Although Jamaica is hardly famed as an astronomical mecca, it has one major underrecognized asset: exquisitely steady seeing. Pickering's private Woodlawn Observatory, founded in 1911 on a former coffee plantation 2,000 feet (610 meters) above Mandeville's haze and dust, featured a 12.5-inch Newtonian reflector housed in a roll-off shelter.

By day, Haas devoured books in the well-stocked astronomical library or studied Pickering's observing notes from the night before. After sundown, he assisted 78-year-old Pickering and absorbed the discipline of the veteran observer's nightly practices: rating the atmospheric seeing, sketching what he saw while still at the eyepiece, and training his eye to recognize details and subtle shades of color.

In short order, Haas was observing the Moon and planets solo. The summer internship was so successful, it was extended from 8 weeks to 15. By late August, Haas was dedicated to the solar system. He also had become friends with Pickering's secretary, Beryl "Peggy" Godfrey, who, years later, he married.

### An early call for action

A month after his return to the States, Haas received a full scholarship to Mount Union College, a small, private, liberal-arts institution in Alliance, Ohio. There, he earned his bachelor's degree in mathematics in 3 years. He also was essentially the sole user of the 10-inch Saegmuller refractor in the college's Clarke Observatory. With it, he embarked on his first serious studies of Mercury, Venus, Jupiter, and Saturn in 1936; he estimated the relative intensity — or brightness — of features suspected of changing.

As an undergraduate, Haas questioned the view widely held among professional astronomers in the United States that, to quote Simon Newcomb in *Astronomy for Everybody* (1926), the Moon was "a world which has no weather and on which nothing ever happens." In the 1930s, only variable stars and meteors were regarded as fields where amateurs could make scientific contributions because professionals had large telescopes and could do astrophotography.

AN INSPIRATION TO MANY, Walter Haas peers through the eyepiece of his 12.5-inch Newtonian reflector in the 1960s. The two teenagers waiting for a view are among the many scientists influenced by ALPO: Gordon Solberg, a former planetary astronomer (left), and Steve Larson, director of the Catalina Sky Survey at the Lunar and Planetary Laboratory in Tucson, Arizona.

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(Image used with permission, courtesy of *Astronomy* magazine.)

### *'An organized group of careful and persistent amateurs could do much of value on the Moon'*

And so the first published words of Walter Haas on the formation of what later became the Association of Lunar & Planetary Observers were stated in a September 1938 article in the *Journal of the Royal Astronomical Society of Canada (JRASC).*

This tidbit and much more are included in a striking profile of the ALPO founder in the March 2005 issue of *Astronomy* magazine. The article includes an account of Walter's early years in astronomy and his questioning of widely held opinions in the 1920s that "only variable stars and meteors were regarded as fields where amateurs could make scientific contributions because professionals had large telescopes and could do astrophotography."

Thankfully, Walter proved them wrong and founded the ALPO in 1947. Today, we have seen contributions by amateurs in so many other areas of astronomy thanks to organizations like ours and even independent studies, as well.

Contact *Astronomy* magazine to secure your own copy of the March issue at http://www.astronomy.com/asy/default.aspx?c=bi&id=32 (or phone 800-533-6644).

### *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/

### *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

## ALPO Observing Section Reports

### *Eclipse Section*

**By Mike Reynolds, coordinator**

Please note that my e-mail address has changed; drmike@astrospace.net

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

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

### Meteors Section
**By Robert Lunsford, coordinator**

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, coordinator**

*March* – The comets section continues to observe Comet 2004Q2/Machholz. In December, as the comet approached naked eye visibility, it showed a faint, broad dust tail and a long, bright ion tail. After the comet passed closest to Earth in early January, the tail grew fainter. By late February and early March 2005, the comet showed no tail at all. It continues to be fairly bright and well-positioned, and should be fairly easy to observe throughout the spring.

Comet 2004Q2/Machholz as imaged by R.B. Minton on March 1, 2005 (No other details available). Source: http://pages.preferred.com/%7Etedstryk/indexc.html

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 Rick Gossett, 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

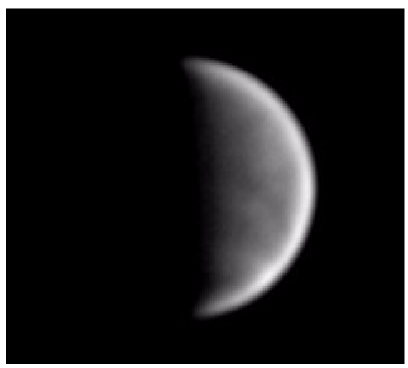
Visit the ALPO Solar Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/solar.html

### Mercury Section
**By Frank J. Melillo, coordinator**

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**

*March* – Analysis of the observations and images from 2003-2004 Eastern (Evening) Apparition is well underway and will appear in this Journal soon. The 2004-2005 Western (Morning) apparition of Venus ended with Superior Conjunction on 2005 March 31. Venus passed through its waxing phases (crescent through gibbous phases) during this apparition and the disc has progressively diminished in angular diameter. Observers witness Venus' trailing hemisphere during western apparitions and view the dawn side of the planet at the time of terrestrial dawn. Observations and images have continued to flow in from observers worldwide (see Pellier image here).



Venus 45% illuminated as imaged by Christophe Pellier, Bruz, France, 15 Aug 2004, 04:56 UT; CCD image made at 3,650 Angstroms in the UV; 18.0 cm (7.1 in) Newtonian reflector; normally inverted image with south at top.

The 2005-2006 Eastern (Evening) Apparition of Venus began rapidly after Superior Conjunction on 2005 March 31, with the planet low in the evening sky in April. Who was the first to see or image Venus during the 2005-06

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

apparition? The planet will reach Greatest Elongation East of 47° on 2005 November 3 at 19:00 UT and become brighter and brighter until it reaches Greatest Brilliancy on 2005 December 9. Therefore, observers should be planning to start observations early in the apparition 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. There is also a definite need for continued 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 patrols for sightings of the Ashen Light are continuing 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 in 2005-2006.

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.

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

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### Lunar Section:
#### Lunar Meteoritic Impact Search
**By Brian Cudnik, coordinator**

*March* – The section was rather active in 2004, with several observing opportunities, those being the Lyrid meteors in April, the June Bootids, the South Delta Aquarids in July, the Perseids in August, the Orionids and a total lunar eclipse in October, the Leonids in November, and the Geminids in December. Aside from the reports of impact candidates that follow, no other impact candidates have been reported for any of these opportunities as of 2 March 2005.

A number of impact candidates were noted during 2004 and the first two months of 2005, mostly non-shower events. These include a video observation made in Italy at 20:23 UT on 03 April 2004, apparently on the dayside but close to the terminator (between crater Cassini and Mont Piton).

The event, likely a pair of cosmic rays, appears to have occurred as a pair of flashes, one bright, another faint, with the second displaced from the first by several arcminutes; the brighter flash occurred on a single frame, but on the very next frame, the

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

brighter flash was gone and a fainter flash, displaced from the first, occurred.

A cluster of impact candidates (4 to 6) occurring between 7:25 – 7:31UT on 28 July 2004 was reported during a period of heavy pollution from a forest fire; once again, all of these occurred on the dayside of the Moon. These observations were made visually by Rick Dewitt and his wife at Mill Creek, WA, USA.

A confirmed impact flash was recorded on 11 August 2004 at 18h28m27s UT, likely derived from the Perseid stream. This observation, made by a team of observers in Japan, was the first non-Leonid confirmed impact event recorded. The team, observing from Shiga and Nagano, included the following: Y. Takamura, H. Masuda (Geological and Astronomical Club, Ichinomiya High School) and Y. Sakai (Ogawamura Observatory); M. Ida and M. Adachi; M. Ishida; K. Ohnishi (Nagano National College of Technology); and Y. Yabu.

Three impact flash candidates were recorded by videotape by Robert Spellman at the TLP Research Observatory in Azusa, CA, at 1:43:36, 2:34:03, and 3:12:29 (all times UT) on 20 November 2004. Finally, Peter Jevne from Minneapolis, MN, and Roger Venable observing from West Summerland Key, FL, have observed a probable impact on 11 February between 0:09 and 0:13 UT (times are uncertain in both cases by several minutes). Given the prominence of the event as reported by both observers, it seems likely that they witnessed the same impact event, yet a confirmation is not possible given the lack of time precision in their reports.

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

### *Lunar Topographical Studies*

**William M. Dembowski, FRAS**
**acting section coordinator**

*January* – During the last quarter of 2004, submissions to the Lunar Topographical Studies Section were noteworthy in their quantity, quality, and variety. Fourteen observers contributed to the section — three of them for the first time. Observations included 78 digital images, 22 ray-maps, 17 sketches, one photograph, and one written account, for a total of 119. This total does not include the timings of 40 stars occulted by the Moon as submitted by Robert H. Hays, Jr. (Illinois, USA). Although the ALPO does not presently have a formal program of occultation timings, the retention of these observations is in keeping with the ALPO Lunar Topographical Studies Section's policy of not refusing any lunar observations because they might prove to be of future value. On a lighter note, we also received a fascinating composite of two Solar System images taken by Howard Eskildsen (Florida, USA) on the morning of December 5, 2004. The Moon was imaged through an 8-inch, f/6 Newtonian and the Sun through a Meade ETX-125 with a Baader visual solar filter.

The Lunar Section Newsletter, *The Lunar Observer*, continues to grow in popularity and stature as a forum for all lunar sections. Among other items, the ALPO Lunar Topographical Studies Section contributed an article by Alexander Vandenbohede (Belgium) on the spherical projection of lunar features using commercial software, and a study by Anthony Ayiomamitis (Greece) of the heights and slope angles of Rupes Recta. Both of these studies are prime examples of how digital imaging is fueling a virtual revolution in amateur lunar science. Vertical studies in particular are seeing a resurgence in popularity because of the ease and accuracy with which digital images can be used. A further application of digital imaging might be found in a program of lunar colorimetric studies being explored by the coordinator, but the validity and value of this study have yet to be determined.

As always, selected contributions to the section are featured in the Lunar Section's newsletter, *The Lunar Observer*, which has been averaging 12-16 pages per month and can be found at http://www.zone-vx.com/tlo.pdf In addition, discussions of the Moon are always welcomed at the Lunar Section e-mail discussion group at http://groups.yahoo.com/group/Moon-ALPO/

For information on how you can participate in the study of the topography of Earth's only natural satellite, contact William Dembowski at Dembowski@adelphia.net

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

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

## 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

## Lunar Selected Areas
**Julius Benton, coordinator**

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

## Lunar Transient Phenomena

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

## Mars Section
**By Dan Troiani, coordinator**
**Daniel P. Joyce, assistant coordinator**

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

## Minor Planets Section
**By Frederick Pilcher, coordinator**

*February – The Minor Planet Bulletin*, Vol. 32, No. 1, 2005 Jan-March, contains lightcurves, and their derived synodic rotation periods and amplitudes, for 39 different asteroids, the highest total yet for a single issue. These include planets 96, 228, 242, 265, 276, 297, 386, 390, 539, 544, 689, 744, 755, 893, 921, 981, 1014, 1062, 1067, 1373, 1584, 1605, 1701, 1853, 2120, 2448, 2771, 3022, 3125, 3693, 4774, 5917, 6490, 6517, 7187, 7757, 10142, 14653, and 18108.

Annual lists for the year 2005 are also published. These include the following:

- Close Mutual Approaches of Minor Planets in 2005 by Edwin Goffin
- Asteroid-Deep Sky Appulses by Brian D. Warner
- Minor Planets at Unusually Favorable Elongations by Frederick Pilcher.

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

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

## Jupiter Section
**By Richard W. Schmude, Jr., coordinator**

*March* – Jupiter reached opposition in April and I hope that many of you observed and continue to observe this planet. One feature that changes very rapidly is the white oval which lies next to a festoon in the EZ. Please watch these elusive features because they can change in only a few hours. The NEB has become wider during the past few months; however the NTB is still invisible. Please watch for the reappearance of the NTB.

Jupiter with Europa as imaged by Christopher Go, Cebu City, Philipines, 5 May 2005, 13:40 UT; CM1 = 356°, CM2= 206°, CM3 = 247°; Celestron C8 on P900GTO mount with Philips ToUcam webcam, Astrophysics Convertible Barlow (BarCon) and Astrophysics Maxbright Diagonal are used to amplify the image. Source: http://www.lpl.arizona.edu/~rhill/alpo/jupstuff/alert/jup050505a.jpg

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

On another note: Brian Sherrod has developed an archiving software package that many people may be interested in; essentially, observers post their own images on the site and fill in the appropriate information. I feel that this has great promise. Details about this new software have been sent to everyone on the Jupiter listserv. If you would like to be included in this list, contact Craig MacDougal.

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

Saturn at opposition as imaged by Jesus R. Sanchez, Cordoba, Spain; 13 Jan 2005, 13 23:30UT; B = -22.8°, CM I = 53.1°, CM II = 277.0°, CM III = 152.6°, S = 7, Tr = 4; scope = 28.0 cm (11.0 in) SCT with Philips ToUcam webcam at f/30.

### Saturn Section
**By Julius Benton, coordinator**

*March* – Saturn is now in the western evening sky in the constellation of Gemini at visual magnitude 0.1, having passed opposition on 2005 January 13. The southern hemisphere and south face of the rings are open to our telescopes during 2005, with the rings inclined at about 23.9° to our line of sight.

Observer response during current 2004-2005 apparition has been tremendous, with hundreds of detailed CCD and webcam images of Saturn arriving so far, along with some very impressive drawings. Those who do imaging of Saturn are reminded to make sure that they do not forget to attempt 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.

Saturn's southern hemisphere has been showing only occasional activity in the form of small white spots and dusky features, most of them very transient in nature, and thus the impression is that things have been rather quiet this observing season, at least through opposition. A sample image by Jesus Sanchez of Saturn at opposition from this apparition accompanies this report.

All reports for the 2003-2004 apparitions have been received, logged into the ALPO Saturn Section database, and are still being analyzed carefully. Because of the sheer numbers of observations, the 2003-2004 apparition report will probably not appear in this Journal until mid-2005.

The ALPO Saturn Section is always eager to enlist new observers, and anyone interested in our programs should contact the ALPO Saturn Section cordinator on how to get started.

Further 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

### Remote Planets Section
**By Richard W. Schmude, Jr., coordinator**

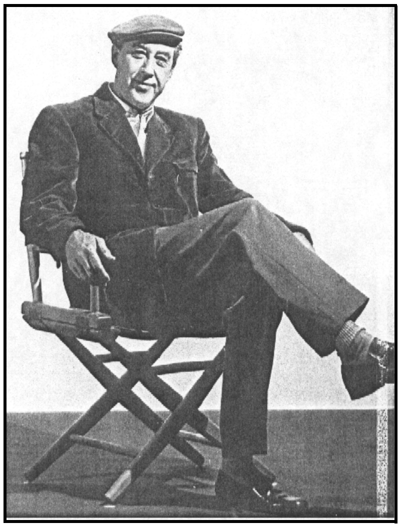
*March* – Please be sure to send in any observations that you made of Uranus, Neptune and Pluto in 2004 or Jan. 2005. I began writing the 2004 remote planets report in May.

Pluto was visible in the early morning sky in April. I hope that people will make brightness measurements of Pluto using a CCD camera. Doug West has had great success doing this in the last few years. Uranus and Neptune will be visible right before dawn in the eastern sky. People living in Hawaii and the southern United States will have a better view of these planets than those living further north.

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

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

## ALPO Member Obituary



### Philip Robert Glaser, August 17, 1914 – April 12, 2005

**By Richard Fink**

Astronomy has lost a fine observer, recorder, practioner and advocate. Phil was born in Blissfield, Michigan, and was married to Virginia Emily Glaser for 60 years, until her passing in 1998.

For 28 years, Phil was president of a branch of the Heyman Mfg. Co. in Waukesha, Wisconsin. During that time, he became very active in his pursuit of astronomy.

He was a member of the Milwaukee Astronomical Society and the Association of Lunar & Planetary Observers (ALPO). Phil was the ALPO Jupiter Observing Section Recorder during the 1960s. Some of his observations were drawn on paper and other views were his spectacular photos of Jupiter that were described in *Newsweek* magazine.

Phil also spent much time observing Mars and created wonderful drawings of what he saw on that planet. A beautiful series has four views dated Aug 14, Sept 4, Sept 13 and Sept 30 — all in 1956. They form a short history of a shrinking Mars polar cap.

In 1980, Phil moved to La Jolla, California, where he continued his observing activities. Of particular note are his photos of the Moon. Unfortunately, his observing horizon was restricted by trees surrounding his patio, but he persisted and the results were noteworthy.

In later years, he took up solar observing with a 'scope dedicated to the H-alpha (Hydrogen alpha) lines. This program involved an exercise in instrument making, which he accomplished with ease, since his instrument-making talents were up-to-date, having been practiced for years. His shop contained a metal-cutting lathe, drill press and a huge variety of hand tools and measuring tools. He also successfully modified ( improved ) commercial tripod mountings to achieve greater stability and ease of use. All this time, he was still taking photos and using his darkroom facility to get the results printed on paper.

While astronomy occupied much of his time, he had other interests that were chief competitors; among them were music, travel, literature, photography, and model boats. Frequently, he could be seen sailing steam-powered models on the Mission Bay Pond in La Jolla. He had constructed the boats from scratch and their sizes ranged from 12 inch to 48 inch waterlines.

One cannot say enough about how wonderful it was to know Phil and have him as a friend, mentor and colleague. He will be – and already is – missed.

He is survived by his children David of Plattsburgh, New York, James of Toronto, Canada, and Judy Osteyee of San Diego, California, as well as five grandchildren and a sister, Natalie Elliott of Freemont, Michaigan, and many, many friends.

## Point of View: Nomenclature

(continued from page 1)

inferior conjunction. For those two planets, a western or morning apparition then lasts from an inferior conjunction to the subsequent superior conjunction.

There is a nuisance in this scheme that there is no time break between the two kinds of apparitions; but if we continue the practice of speaking of elongations of Mercury or Venus, we need to decide to what elongation an observation made on the day of inferior conjunction belongs! Perhaps that date might logically be the end of an evening apparition and also the start of a morning one.

In the literature, apparitions have sometimes been bounded not by the exactly known times of conjunctions with the Sun, but by the dates of the first and last observations which a group secures. These vary with the skill and persistence of the observers so that an exact definition is to be preferred.

Perhaps we should not try to teach terminology in a science where we have waterless seas on the Moon, canals of dubious objectivity on Mars, and barges not made with human hands on Jupiter. It appears proper that much of the current literature now calls the maria of Mars what they are: "albedo features". May we hope that "apparition" can also receive wider usage?

*Feature Story:*

# Solar Observing — A White Light Primer

**By Jamey Jenkins, assistant coordinator, ALPO Solar Section; e-mail to: j***enkinsjl@yahoo.com*

Did you ever see a star so near that you could spy on the way its gas and magnetic fields interplay? If you spend all your observing time with the night sky, exploring stars and planets, your answer would be a resounding - NO! But, venture out with a telescope under the daytime skies and a whole new avenue of astronomy awaits.

The Sun offers a unique opportunity to explore the workings of an average star from your own backyard. A virtual hodgepodge of activity is visible to the curious backyard observer. If you're on a shoestring budget, no expensive telescope accessories are needed, just a few pieces of wood, cardboard, and glue. White light observing or viewing the Sun as it naturally appears in the sky is an exciting gateway into the world of daytime astronomy.

For the uninitiated, this is an invitation to brave the day and experience the solar system's most dynamic body, the Sun.

## Safety Comes First in Solar Observing

The lesson that must be taught of every potential observer of the Sun is this: "Anyone looking even the shortest amount of time at the Sun through an optical instrument will forever damage his eyes UNLESS special equipment or techniques are used!" It only requires a careful attitude and proper knowledge to safely observe the Sun without the slightest fear or reservation. Many observers do this on a daily basis.

The safest method of solar observing is the projection method, where the Sun's image is viewed indirectly as it is projected by the telescope's eyepiece onto a white screen. In the ALPO Solar Section, we recommend the use of a Hossfield Pyramid for projection viewing (see *Figure 1*).

Named after the former chairman of the AAVSO Solar Division, the device is simply a pyramid-shaped box constructed of sturdy cardboard or thin wood. The small end of the pyramid is attached to a projecting eyepiece and the viewing screen is located at the base of the pyramid. Paint the inside of the box flat black and provide an opening on one side to allow the observer to see the projection screen clearly.

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- Left-click your mouse on "*Figure*", "*Table*" or *reference citation* to jump to that particular item.

When attached to a star diagonal, the open side of the pyramid is always in the shade, providing a bright contrasty view of solar features.

Rather than using high-priced eyepieces for solar projection, instead invest in inexpensive eyepieces for this activity. Also, avoid eyepiece designs which use cement between the elements, since optical cement can melt from the heat of the Sun at the focal plane

Figure 1. A Hossfield Pyramid constructed of black foam board with a bristol board projection screen. When used in this position, along with a star diagonal, the screen is always shaded, thereby permitting bright, contrasty views of the Sun.

**Table 1:**

| Color | Wratten Filter | Spectral Transmission | Application |
|---|---|---|---|
| Dark Red | 29 | 6100-7000+Å | Red and orange filters increase the contrast of knots and radial streaks in the penumbrae of sunspots. |
| Red | 25A | 5900-7000+Å | |
| Light Red | 23A | 5700-7000+Å | |
| Orange | 21 | 5400-7000+Å | |
| Yellow | 11 | 4200-7000+Å | Yellow...neutral, all-around filter that lessens achromatic color errors. |
| Light Green | 56 | 4600-6200Å | Green filters increase the visibility of granulation and faculae. |
| Green | 58 | 4700-6100Å | |
| Dark Green | 61 | 4800-6000Å | |
| Blue | 47 | 4000-5200Å | Blue will assist in seeing faculae further from the limb than normal. |

of a telescope, destroying the eyepiece. The older Ramsden and Huygens designs are ideal for solar projection.

Another method of solar observing is direct viewing through the telescope. This is accomplished by reducing the light intensity many thousands-fold with acceptable safe filtering appliances. Over-the-objective filters of glass or mylar are available from several sources. An objective lens filter must reduce the brightness of the Sun to a comfortable viewing level AND remove the dangerous infrared and ultraviolet light. Once these conditions are met, the quality of the filter must be considered. Quality is determined by the amount of wavefront error a filter contributes to a telescope's performance. Put another way, lower quality filters tend to distort the view more than higher quality filters.

Mylar filters generally don't vary much in quality within a particular brand because of manufacturing tolerances of the substrate and coatings. Glass filters can fluctuate from poor to excellent depending on manufacturing methods and a bit of luck. The finer (and costlier) glass filters require handwork to figure both sides of the filter, thereby insuring the accuracy of the optical surfaces, just like a telescope's objective lens or mirror. Remember that with glass filters, the surface accuracy must exceed that of the other elements in the tube assembly or else the performance of the telescope will be compromised.

Rule-of-thumb: obtain the finest quality filter you can afford.

## About Seeing

"Seeing is everything", said one veteran solar observer. This refers to the blanket of air surrounding our planet and how it affects our view of the celestial bodies in space. As with planetary observing, the atmosphere plays havoc with our view of the Sun. In solar observing this is even more pronounced as the Sun tends to heat up our surroundings and the nearby air, further increasing the turbulence. The upper atmosphere causes problems, but the first 100 meters of air above ground level generally is the cause of 90% of local disturbances.

So, what do you do? Several ideas come to mind:

- Avoid buildings near or beneath the path of light between you and the Sun.
- For those with an observatory, an open air shelter is the better arrangement, one with a rolling or split roof. Domes tend to create and maintain poor seeing.
- Locate your observing site in an area where the prevailing winds are not blocked.
- Except for interior surfaces in the telescope avoid flat black. White paint reflects heat while black absorbs it, radiating the heat back into the light path of the telescope.
- Study your local seeing conditions and note when the prime solar observing time is for you. Perhaps your best seeing occurs early in the morning, before the Sun has had a chance to heat up the local rooftops; or maybe with the Sun high in the sky with a light east-west breeze.

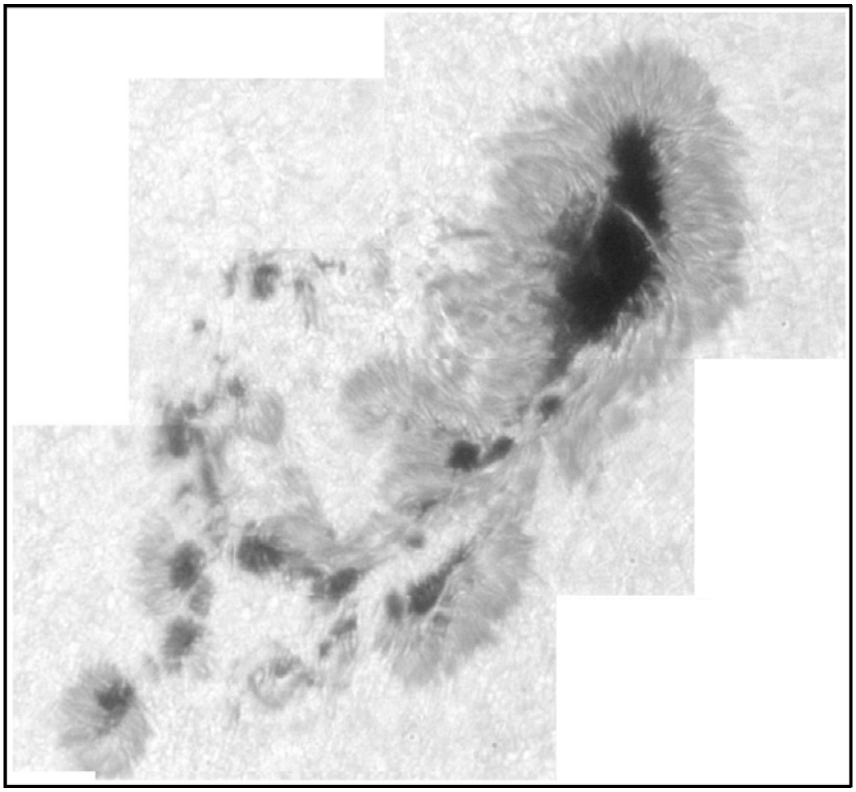

Figure 2. Closeup of Active Region 10119, from September 21, 2002 by observer Art Whipple using an 8-inch unsilvered primary mirror, a 9nm interference filter centered on 520nm, projection lens and a video recording system. This image clearly shows granulation, internal umbral details, penumbral filaments and a thin light bridge crossing the main spot's umbra.

Narrowband filters are also a useful tool. The prismatic effect of our atmosphere, called "atmospheric refraction", is a deteriorating effect. This results in a loss of clarity as an object passes through the thick layer of atmosphere near the horizon. As soon as you get more than 25 degrees away from the zenith, this refraction becomes greater than one arc second.

The way around this deterioration is to filter the image so you observe in only one color. The narrower the bandwidth of the filter, the lower in the sky you can achieve a potential resolution of arc second quality. Many observers favor a filter centered on 520 nm (5,200Å) in the green portion of the spectrum. Such a filter with a bandwidth of approximately 9 nm will significantly improve the appearance of granulation and facula. A similar effect can be obtained with deep green planetary filters.

The point is to be alert and discover the conditions when seeing is better to optimize your observing time.

## Colored Filter Tricks

Solar observers use colored filters in combination with safe direct view filtration to enhance the visibility of features (see *Table 1*). Consider the objective filter for a moment. Glass filters are often given metallic coatings that render an orange color to the Sun. Red/orange filtration increases the contrast of knots and streaks in the penumbrae of sunspots. Faculae and granulation will be somewhat diminished with that filter scheme. A glass filter that transmits primarily toward the red end of the spectrum is therefore biased toward sunspot detail.

Mylar type filters often favor the blue portion of the spectrum, performing better on granulation, faculae, and white light flares. It should be obvious that the better choice for an objective filter would be one that yields as flat a spectral response as possible. That is, one transmitting a neutral, basicly white image of the Sun. By simply pairing up a corresponding eyepiece filter with that objective filter, nearly all white light features can be observed equally well.

## Solar Features

The face the white light Sun presents to the observer is one of ever changing appearance. You will never repeat a single observation, each view is totally unique. It is that quality which is so appealing to the amateur astronomer regarding solar observing. The Sun is indeed the most dynamic body in our solar system.

As you look at the face of the Sun in white light, you will notice dark patches on the visible surface or photosphere. These are sunspots. Sunspots are the result of magnetic fields being generated by the rotation of the Sun and the boiling motions of convection in the Sun's outer layers. Through these motions, creation of electrical currents give birth to magnetic fields, which evolve further through an all-repeating cycle of stronger current and magnetism. Eventually, a field is powerful enough to rise to the surface with its pocket of gas and become what is known as an active region.

Individual spots are themselves composed of several parts: a darker center called the umbra, surrounded by a less dark penumbra. If your sky is unusually calm, you may see that the penumbra itself is composed of many dark hair-like penumbral filaments radiating outward from the umbra with brighter penumbral grains trapped between them. Individual sunspots occasionally are crossed by bright streaks without internal structure called light bridges.

Notice also that the spots tend to cluster into bunches known as sunspot groups. Sunspot groups are classified according to their characteristics by a system known as the McIntosh Classification System. Devised by Patrick McIntosh of the National Oceanic and Atmospheric Administration's Space Environment Services Center in 1966, this three-letter system is used by the ALPOSS observers to describe a group's stage of development and as an indicator of possible flare production.

The entire visible solar disc is a mottled surface known as granulation. Some of the cells of this granulation may be filled in, but they are not as dark as the umbra in sunspots. The larger of these dark cells are called pores. Surrounding the sunspot groups, especially visible near the limb are bright venous patches called faculae.

Occasionally, a facular region will be bright enough to be seen well into the disc, but this is rare. All sunspot groups are associated with facular regions but the opposite is not true. Faculae can exist without the presence of a sunspot group, as in the case of polar faculae, whereupon sunspots are never seen farther from the solar equator than a heliographic latitude of 50 degrees.

## Contributing to the Solar Section

Since 1982, the Solar Section of ALPO has been collecting and reducing solar observations to provide useful data to professional and nonprofessional researchers. Observers from around the world submit data on a daily basis of the changing appearance of the Sun. This change in appearance is called morphology. Solar observing is such a rewarding and exciting activity that we in the Section want to encourage and assist more amateurs to contribute to this ever growing database.

The white light program of this Section is divided into three distinctly different areas:

- Recording solar morphology through drawings
- Photography of whole disc and active regions
- Patrolling for and observation of White Light Flares

A significant group of observers contribute in monochromatic light. If you are so equipped, we would also welcome your work in that area.

Submissions of observations are made much easier these days through e-mail services via the Internet. Typically, observations arrive daily in the coordinator's mail box, are archived and then are posted on the Solar Section's website at the "Recent Observations" page. We maintain contact with our members through our e-group, Solar-ALPO, which is found on the Yahoo! system at:

*http://groups.yahoo.com/group/Solar-ALPO/*

There, members may post messages, discuss helpful information and upload photos or files they wish to share. To find out more information regarding the ALPO Solar Section or to become an active contributor contact: Rick Gossett, Solar Section Coordinator at 20251 Lakeworth, Roseville, MI, 48066; e-mail: *rick2d2@sbcglobal.net.*

## References

Hill, Richard E. & Kalinowski, Laarry F. *The New Observe and Understand the Sun*, 2000, The Astronomical League.

*Guidelines for the Observation and Reporting of Solar Phenomena*, ALPO Solar Section, 2005.

## Upcoming Solar System Events

### June

June 12th, Sunday: Pluto at Opposition
June 14th, Tuesday: First Quarter Moon
June 15th, Wednesday: Moon near Jupiter.
June 16th, Thursday: June Lyrids Meteor Shower.
June 21st, Tuesday: Summer Solstice occurs at 06:46 UT
June 22nd, Wednesday: Full Moon
June 25th, Saturday: Conjunction, Venus-Saturn.
June 26th, Sunday: Conjunction, Mercury-Saturn
June 27th, Monday: Conjunction, Mercury-Venus
June 28th, Tuesday: Last Quarter Moon
June 29th, Wednesday: Moon near Mars

### July

July 3rd, Sunday: Mercury & Venus in M44
July 5th, Tuesday: Earth at Aphelion
July 6th, Wednesday: New Moon
July 7th, Thursday: Conjunction, Mercury-Venus
July 8th, Friday: Grouping of the Moon, Mercury, & Venus
July 9th, Saturday: Mercury at Eastern Elongation
July 14th, Thursday: First Quarter Moon

**Feature Story: Collisions in Space**

# Observing the Impacts of Meteoroids on the Lunar Surface

**By Brian Cudnik and Roger Venable**
*cudnik@sbcglobal.net* and *rjvmd@knology.net*

## For Online Readers

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•Left-click your mouse on "*Figure*" or "*Table*" to jump to that particular item.

## Introduction: What Do They Look Like?

Since the confirmed Lunar impacts of Leonids in 1999 (*Dunham et al, 2000*), Leonids in 2001 (*Cudnik et al. 2003a*), and Perseids in 2004 (*Yanagisawa and Ohnishi, 2004*), interest in the observation of Lunar meteors has been high. An opportunity to see them occurs every month, when the Moon is visible in the evening sky as a waxing crescent. (The sunlit portion of the Moon gets too bright about two days after first quarter. There is an equally good oportunity in the morning sky on a waning crescent, and also during eclipses of the Moon which allow coverage over a huge geographical area on Earth but seldom when a known major shower is active.)

An impact flash resembles a star that appears for only about 1/15 second. Although this is easily missed visually if one blinks at the wrong moment, it can be captured on two video frames. On video, the impact has the appearance of a star, complete with a fuzzy boundary caused by atmospheric seeing / blurring. We have archived 10 videotaped impact flashes. As an example, one is displayed in *Figure 1*.

## Impact Flashes and Lunar Transient Phenomena

Lunar Transient Phenomena, or LTP, are defined as changes on the Moon. A wide variety of such phenomena has been reported over the past several hundred years and is documented by various sources. Manifestations of LTP include color changes, localized clouds or obscurations, haze spots, lightning, point flashes lasting anywhere from a fraction of a second to several hours, plumes, and other forms of change occurring on time scales of seconds to hours (*Cameron, 1978*). A few of these, such as localized clouds or hazes, plumes, and flashes, may be visible manifestations of the collision between a meteoroid and the lunar surface. In fact, the lunar impact phenomenon is a subset of LTP, but only certain forms of LTP may be regarded as manifestations of impacts.

Probably the most common form of visible impact phenomena is the point flash, described in the introduction above. The point flash is best seen on the unilluminated portion of the Moon, where contrast between the flash and the surroundings is maximized. The bright background of the sunlit side overwhelms all but the brightest (and rarest) of impact flashes (except, perhaps, for infrared observations).

Now that we know what meteor impacts look like on the Moon, it is reasonable to consider LTP events which have features inconsistent with these impacts to be non-impact phenomena of a nature that is, so far, undetermined. One example of such an event is the long-duration flash that Stuart observed in 1953, which lasted at

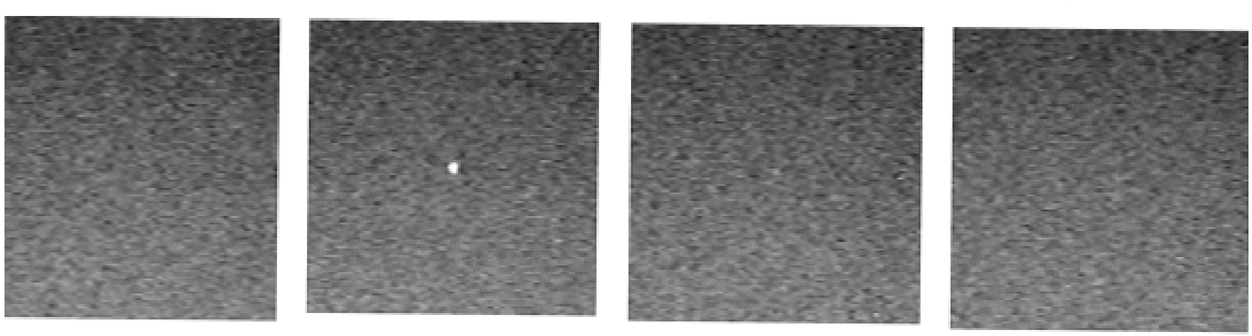

Figure 1. Sequence of images from a video by David Dunham, president of the International Occultation Timing Assn (IOTA), that documents the impact flash observed visually by Cudnik on 18 November 1999. The first frame is just prior to the event. The second frame, 1/30 second later, shows the peak optical output of the event, and the third frame, 1/30 second after the second frame, shows an "afterglow". The final frame, 1/30 second after the third, shows that the flash has faded below the sensitivity of the system.

**Table 1: Sample List of Time Signals (Adapted from *Betke, 2003*)**

| kHz | Call sign | Location | Mode |
|---|---|---|---|
| 40 | JJY | Mt. Okakadoya, Japan | CW |
| 60 | JJY | Mt. Hagane, Japan | CW |
| 60 | MSF | Rugby, United Kingdom | CW |
| 60 | WWVB | Fort Collins, Colorado, USA | CW |
| 66.67 | RBU | Moskva, Russia | AM |
| 75 | HBG | Prangins, Switzerland | CW |
| 77.5 | DCF77 | Mainflingen, Germany | CW |
| 100 | | Worldwide | Loran-C |
| 1510 | HD21OA | Guayaquil, Ecuador | AM |
| 2500, 5000, 10000, 15000, 20000 | WWV | Fort Collins, Colorado, USA | AM |
| 2500, 5000, 10000, 15000 | WWVH | Kekaha, Hawaii, USA | AM |
| 3330, 7335, 14670 | CHU | Ottawa, Canada | AM USB |
| 4996, 9996, 14996 | RWM | Moskva, Russia | CW |
| 5000 | YVTO | Caracas, Venezuela | AM |

least 8 seconds. For all intents and purposes, we restrict identification of impact events to point flashes lasting less than one second.

## Why Look for Impacts?

Although much has been written about the theory of impacts, those writings have been based on the observation of impacts in laboratories. These imapcts were of quite low velocity compared to actual lunar meteoritic strikes, and the conditions of vacuum, temperature, and materials were often not well-simulated (*Schultz, 1996*). As a result, one recent publication presented calculations showing that the visible glow of a meteor impact on the Moon should be visible for only 0.001 (one-thousandth) of a second (*Artemieva et al, 2000*). Our video records of actual impacts show that the glows may be visible for more than 30 times that long! It is by observation of actual impacts that the theory will be advanced. We don't know what fraction of an impactor's energy is radiated as light. We don't know how much energy an impact must release to be visible on the lunar surface from Earth.

The upcoming 2005 Perseid shower (August) provides amateurs with a good opportunity to do this.

If Earth and Moon intersect a broad meteor stream together, the meteors seen in the atmospheric shower will correspond to the impacts detected on Luna: the velocities, particle sizes, and population index will be the same in both. A large team of special observers scattered around the world could observe the Moon well during the peak days of the shower, and by correlating their observations with the simultaneous observations of visual observers, their observations could reveal the size of the particles in the recorded impacts, and the fraction of energy that is released as light.

## What Equipment Do You Need?

The equipment you need depends on whether you plan to observe visually or by video. Some advantages of video over visual include the permanency of the record, the indisputability of the data, the unblinking nature of the CCD chip, and the ability to work several hours without fatigue or having to take a break. But visual observing is not subject to the technical difficulties of video.

- Visual — The visual observer needs a telescope, a radio time signal, and a tape recorder to record his/her voice over the time signal at the moment a flash is spied. A map of the Moon – perhaps with the terminator line already drawn on it – to plot any observed flashes is also required.
- Video — For those who wish to observe by video, a black and white, highly sensitive "security" videocamera is best. The PC23C was the standard for years among astrovideographers, and it may still be the best – it is the camera that is most likely to give good results without making other special adaptations to your equipment. It has a switch that allows you to turn off the automatic gain, leaving the camera in its most sensitive mode. That is how you want to use it. The PC164C is a newer-technology camera that is much more sensitive, but it comes

with an automatic gain control that cannot be disabled without making an internal modification to the electronics (as done by some observers). The automatic gain control will react to the glare of the nearby sunlit portion of the Moon by turning down the sensitivity to less than the desired level.

This glare is especially problematic with Schmidt-Cassegrain telescopes, but it may be less of a problem with well-baffled Newtonians and refractors, provided that the mounting is good enough to keep the telescope pointed always at the dark side of the Moon. Both the PC23C and the PC164C are available from Supercircuits (One Supercircuits Plaza, Liberty Hill, Texas 78642, USA, http://www.supercircuits.com). These cameras use 12-volt power, and the transformer can be ordered from Supercircuits or purchased in the USA at any Radio Shack store.

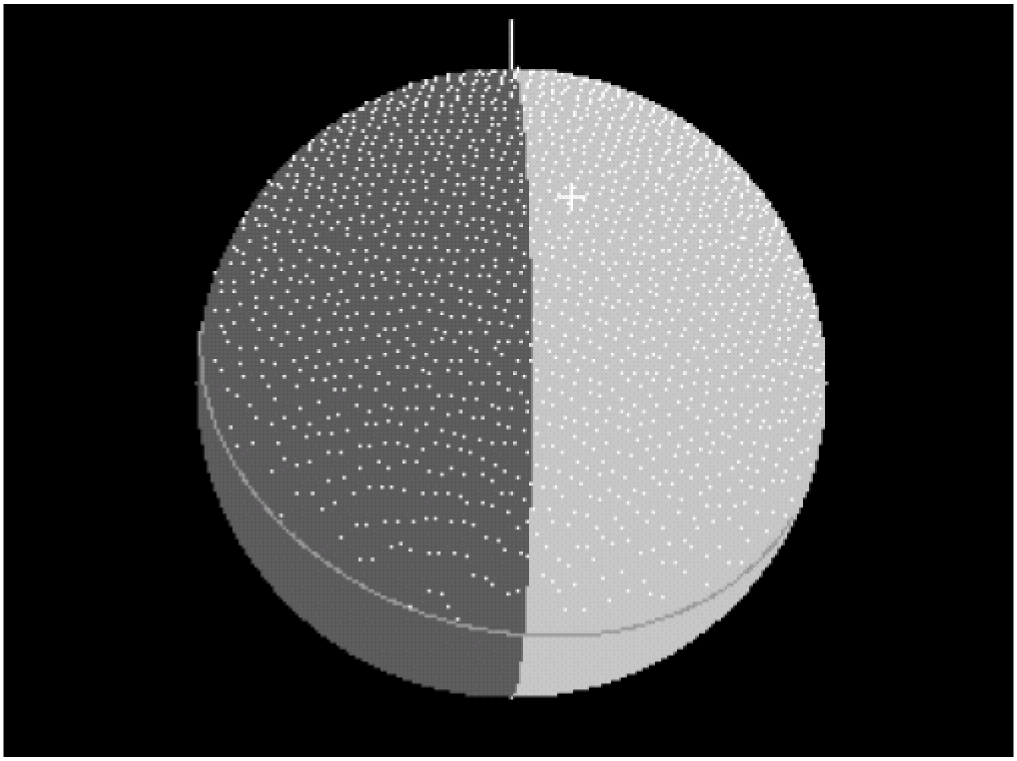

Figure 2. Diagram of the Moon as it will appear on or about August 12, 2005, with light points distributed according to the expected density of Perseid impacts. This view includes most of the lunar hemisphere which will face the Earth (note that north is at the top). The light gray half on the right represents the sunlit half, which effectively washes out almost all Perseid impact flashes. Most of the left half is covered in points, representing regions receiving hits from the Perseid meteors. The white cross near the top of the lunar disk on the sunlit side, represents the sub-radiant point on the Moon. In other words, an astronaut standing at that location would see the Perseid radiant directly overhead. Impact plot courtesy of Peter Gural of the Science Applications International Corporation.

*NOTE: Frame-summing systems such as the Astrovid camera are unlikely to yield useful data unless they are used in non-summing mode, and in that mode, they are less sensitive. Webcams have large time gaps between frames so that they are not useful for this type of recording.*

- Record the Moon's dark side on standard videotape — You need a system of inserting the time into your video record. An easy way to do this is to use a shortwave radio to blare a radio time signal into a microphone as you record (A list of some radio time signals is found in Table 1.) Some microphones don't have preamplifiers, so you will need a preamplifier designed for this purpose to record directly onto the videotape. Radioshack sells a small microphone with an included preamplifier. Another easy way to document the time on your videotape is to record a television time display such as that of the *Weather Channel* at the beginning and end of the recording without turning the videocamera off in between the two recordings of the time signal. The time of impact events can then be interpolated on your tape with reasonable accuracy.

Since the observation is made of the dark side very near the sunlit portion, a telescope with little scattered light is preferred. To ascertain whether your equipment is likely to work, you may wish to practice on the first quarter Moon at night. If your equipment can reveal the difference between the dark side and the background sky, it will work.

A videocamera will record fainter impacts if the telescope's focal length is short, because more of the light is concentrated on a single pixel (Venable, 2003). Furthermore, a short focal length will widen the field of view so that more impacts are included in it. We recommend the use of focal reducers for Schmidt-Cassegrain telescopes and for any telescope to which a compression lens can be conveniently adapted. You don't need a big telescope. Most of the recorded impacts have been detected with small instruments, such as the 125-mm (5.0 in.) Schmidt-Cassegrain used by David Dunham.

## How Do You Review Your Videotape?

When we first looked for impacts during the 1999 Leonid storm, we reviewed the tapes laboriously, frame by frame over many hours. Now we know that many impacts are bright and saturate the pixels of a sensitive videocamera.

They can be detected on full speed review of the tape. Watch very carefully at full speed, and you will see a momentary, star-sized flash on the tape every minute or two. Most of these are cosmic ray hits.

To differentiate them from meteor strikes, review the tape repeatedly at full speed, noting the second in which the flash occurred, until you are sure of which second it is. Then review the tape again, stop just before the second of the flash, and step through the recording frame by frame. If it is a meteor strike, it will be visible in the same spot on the screen in more than one frame. If it is a cosmic ray hit, as most of them will be, then it will be seen in one frame only, or not at all.

The reason that half of cosmic ray hits are not visible at all on frame-by-frame step-through is that this mode of review shows only every other field. The video has 30 frames per second in the United States, 25 in Europe. Each frame is an interlacing of two fields, so that the fields are recorded at twice the frame rate. A cosmic ray hit is virtually instantaneous so that it appears on only one of the two fields in the frame, and it may not be the one that is displayed on step-through.

Should you find a meteor strike, report it to Brian Cudnik at *cudnik@sbcglobal.net* or by regular mail to Brian Cudnik, 11851 Leaf Oak Drive, Houston, TX 77065.

## A Call for Observations!

The next good opportunity to record meteors striking the Moon is the Perseids of this coming August. The peak probably will be within an hour of 18:30 UT on 12 August 2005. The Perseid shower's full width at half maximum is longer than 60 hours, so good observations can be made for more than a day before or after the peak. The Moon will be slightly younger than first quarter during most of the observing period — first quarter is at 02:39 UT on 13 August and resembles the image in *Figure 2*.

Remarkably, the subradiant point will be sufficiently near to the center of the Moon that meteor impacts should be seen with nearly equal frequency at any point on the dark side except the very southern portion! Observers should position the field of view centered a little north of the center of the Moon and showing a maximum area of the dark side, without admitting sufficient light from the sunlit part to down-regulate the camera's sensitivity.

Be sure to record a few stars on the video before you turn it off. This will enable you to estimate the brightnesses of the impacts you record, in comparison to the stars.

The Moon will be at a southern declination, so Northern Hemisphere observers should plan to observe from a site that has an unobstructed southwestern horizon.

Good luck with your observations, and let us know how you do! Negative as well as positive reports will be greatly appreciated!

**Table 2: Meteor Showers with Favorable Viewing Geometry (2005)**

| Meteor Shower | Date | r | Velocity (Km / sec) | ZHR (No. / hr) | Lunar Age (days) |
|---|---|---|---|---|---|
| S. δ Aquarids | 2005 July 28 | 3.2 | 34 | 20 | 21 |
| Perseids | 2005 Aug 12 | 2.6 | 59 | 100 | 6 |
| S. Taurids | 2005 Nov 5 | 2.3 | 27 | 5 | 3 |
| Puppid/Velids | 2005 Dec 7 | 2.9 | 40 | 10 | 5 |
| Ursids | 2005 Dec 22 | 3.0 | 33 | 10 | 20 |

NOTE: The variable "r" is the "population index" of the meteor stream and is expressed as the number of meteoroids of mag + 1 is "r" times the number of meteoroids of magnitude "m". For example, for the Perseids, with an r value of 2.4, one expects 2.4 times more meteors of magnitude 1 than those of magnitude 0. Also, meteor showers with r values between 2.0 and 2.5 are brighter than average (a bit more favorable lunar meteor candidates); those whose r values larger than 3.0 are fainter than average (not so good for producing lunar meteor impact flashes).

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## *Feature Story:*
# *A Study About a Lunar Dome Near the Crater Turner*

**By Raffaello Lena, Rodrigo Viegas, Eric Douglass and Cristian Fattinnanzi (The Geologic Lunar Research Group)**
**Mr. Lena at** *gibbidomine@libero.it,* **Mr. Douglass at** *ejdftd@mindspring.com*
**Peer review by Roger Venable at** *rjvmd@knology.net*

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- Items labeled "Table" to jump to that particular table.
- Items labeled "Figure" to jump to that particular figure.
- In the References section, items in blue text to jump to source material or information about that source material.

## Introduction

The study of domes provides lunar observers with an opportunity for systematic study of the Moon using visual and CCD imaging techniques.

Lunar domes are formed either by outpouring of magma from a central vent or by a subsurface accumulation of magma that causes an up-doming of the bedrock layers, creating a smooth, gently sloping positive relief [*Wilhelms, 1987*].

Domes appear to occur principally in clusters in the dome-rich region of Oceanus Procellarum, near the craters Marius, Gruithuisen, Hortensius, and in the area around Gambart B and C.

Many observers have studied the dome field near the crater Gambart. The ALPO Lunar Dome list reports several low domes in this region (*Table 1*). Observation of these domes requires low solar altitude for maximum detail.

Recently this region was very well monitored by the Geologic Lunar Research Group (GLR). In addition, a low feature has been observed in this area, near the crater Turner and it is reported here.

This feature, located at Xi -0.252 and Eta -0.012 (longitude -14.62° W, latitude -0.71° S), requires very specific lighting conditions to be visible.

Our study of this elusive dome includes CCD images, which has made it possible to extract additional information for its classification.

## Observations and Images

On December 31, 1999 at 05:53 UT, Viegas observed a low relief near Turner (co-longitude 192.5°, solar altitude over the dome 2.07°).

The structure lies about 100 km from the well-known Gambart domes. This observation was carried out under good seeing conditions using a 114 mm (approx. 5-in.), f/8 Newtonian telescope (*Figure 1*). It was then reported to the GLR and further research was carried out.

A CCD image by Fattinnanzi was taken on May 20, 2002 at 19:42 UT (co-longitude 16.5°, solar altitude

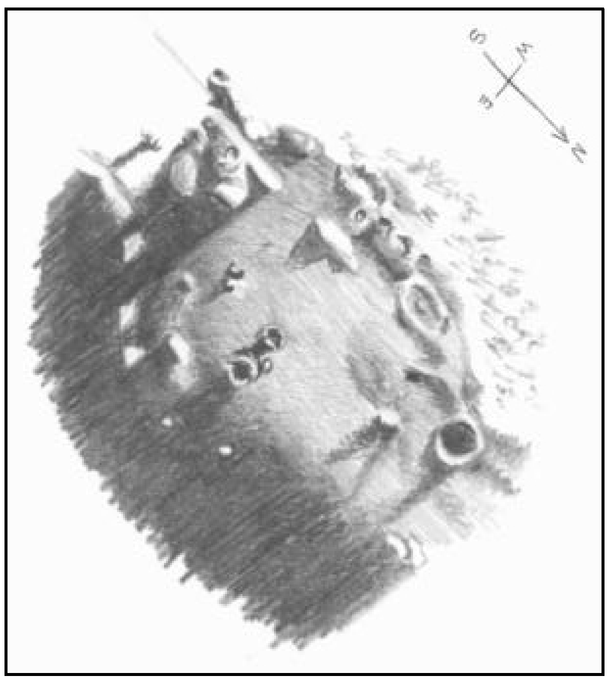


Figure 1: R. Viegas, observation carried out on December 31, 1999 at 05:53 UT (Co-longitude 192.5°, Solar Altitude over the dome 2.07°). South at the top and west (IAU) at the right.

**Table 1: Domes in Gambart Region Reported in the ALPO List of Lunar Domes**

| Longitude (°) | Latitude (°) | Diameter (km) | Remarks |
|---|---|---|---|
| -11.070 | 0.286 | 13 | Mountain spur on north slope |
| -11.438 | 3.153 | | Ridge, probably not a dome |
| -12.255 | 2.809 | 17 | |
| -12.328 | 3.957 | | ridge |
| -12.367 | 2.350 | | |
| -12.381 | 3.555 | | unconfirmed |
| -12.603 | 2.407 | 9X11 | |
| -12.854 | 3.727 | 12X12 | |
| -14.301 | 0.745 | 13 | |
| -14.481 | 1.203 | 10 | |
| -14.899 | 1.719 | 20 | |
| -15.963 | 0.516 | 6.2 | |
| -17.160 | 0.917 | | |
| -17.521 | 1.089 | | |

over the dome 1.94°). As depicted in the image (*Figure 2*), there are several features on its surface, including 2 craterlets and at least 1 cleft. The cleft can be seen to bisect the dome diagonally.

Also, in *Figure 2* the dome appears low from the fact that its shadow was not black at the time image was taken (Solar Altitude over the dome 1.94°).

On the other hand, this dome was imaged by the Apollo 12 cameras (*Figure 3*, AS 12-50-7438).

Lunar Orbiter imagery (*Figure 4*) reveals much finer detail in the dome than can be detected by traditional Earth-based imaging, including several rilles.

Using all the available images, we were able to measure the diameter and position of the unlisted dome. These dimensions were obtained by enlarging the images, counting the number of pixels in the object of interest, and then converting these data into kilometers (*Table 2*).

The dome located at Xi -0.252 and Eta -0.012 is a flat structure of 19.5 km in diameter and circular in shape.

Figure 2: C. Fattinnanzi observation carried out on May 20, 2002 at 19:42 UT (Co-longitude 16.5°, Solar Altitude over the dome 1.94°). South is at the top and west (IAU) to the right.

**Table 2: Details of the Lunar Dome Near Crater Turner**

| Position Lunar Orthographic Coordinates $\xi$ | $\eta$ | Position Longitude (°) | Latitude (°) | Diameter (km) |
|---|---|---|---|---|
| -0.252 | -0.012 | -14.62° | - 0.71° | 19.5 |

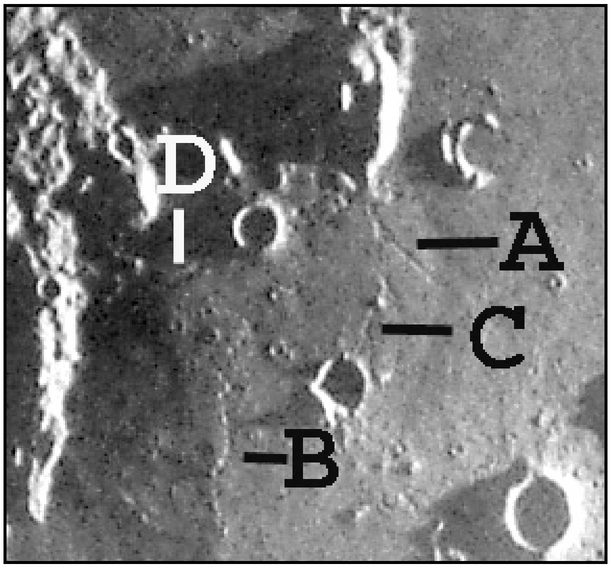


Figure 3: AS12-50-7438; from: Apollo 12, Preliminary Science Report. North is at the top and west (IAU) at the left.

## Geology

Domes are volcanic products. These structures may form as effusive shield-like volcanoes or may remain subsurface as laccoliths. In the former scheme, thin lava flows accumulate around the vent, slowly building up a volcano on the lunar surface. As the lava itself has low viscosity (due to the low silica content; *Mursky, 1996*), these volcanoes have little positive relief, and have slopes of very low incline.

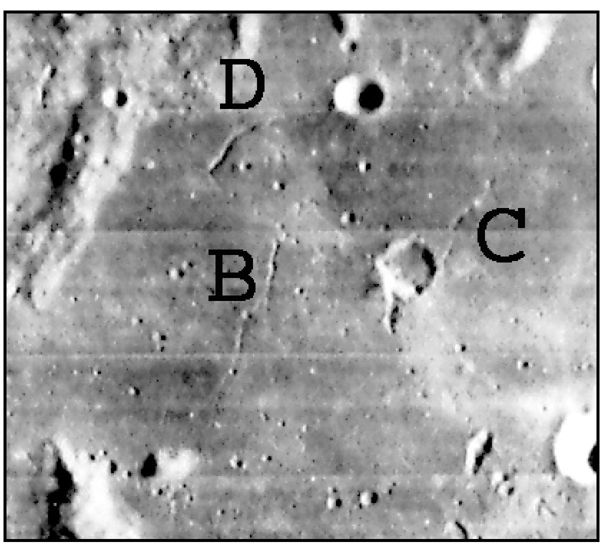


Figure 4: Lunar Orbiter 4, H-113; from *Wilhelms*. North is at the top and west (IAU) at the left.

In the latter scheme, magma accumulates within the lunar crust, increasing in pressure slowly, causing the crustal rock above it to bow upward. This creates a structure of low positive relief, having slopes of very low incline, without ever necessarily having external eruptions (though they can rupture the roofs; MacDonald, 1972).

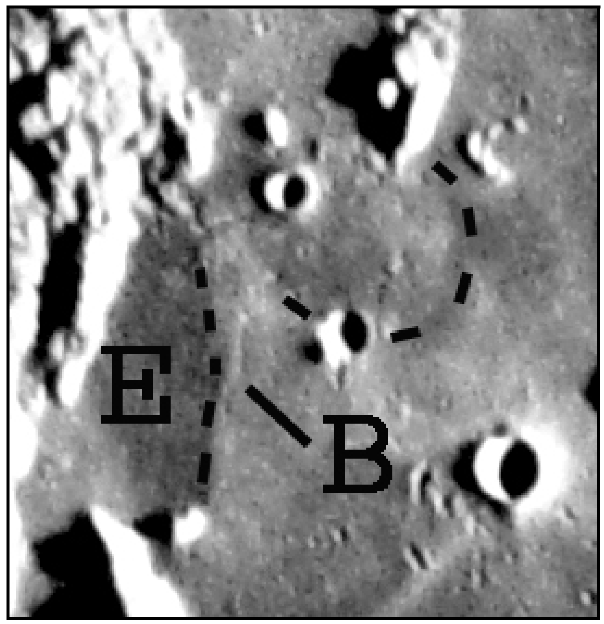


Figure 5: Consolidated Lunar Atlas, E 14. North is at the top and west (IAU) at the left.

For many domes, it is not possible to determine the mode of formation, as the clues of a central pit and/or lava flow boundaries are missing (these would point to an effusive volcano).

In the present example, neither of these characteristics is present. However, one clue does point towards this being a laccolith. In the northern part of this dome there is a rille (*Figure 3, marked "A"*). Most rilles that form in extrusive volcanism are sinuous (i.e., they meander) and flow out onto a mare surface, with the rille being traceable for some distance on the mare surface (cf. Hadley Rille). These form as a result of thermal erosion/positive construction from running lava (*Frankel, 1996*), and so their course is

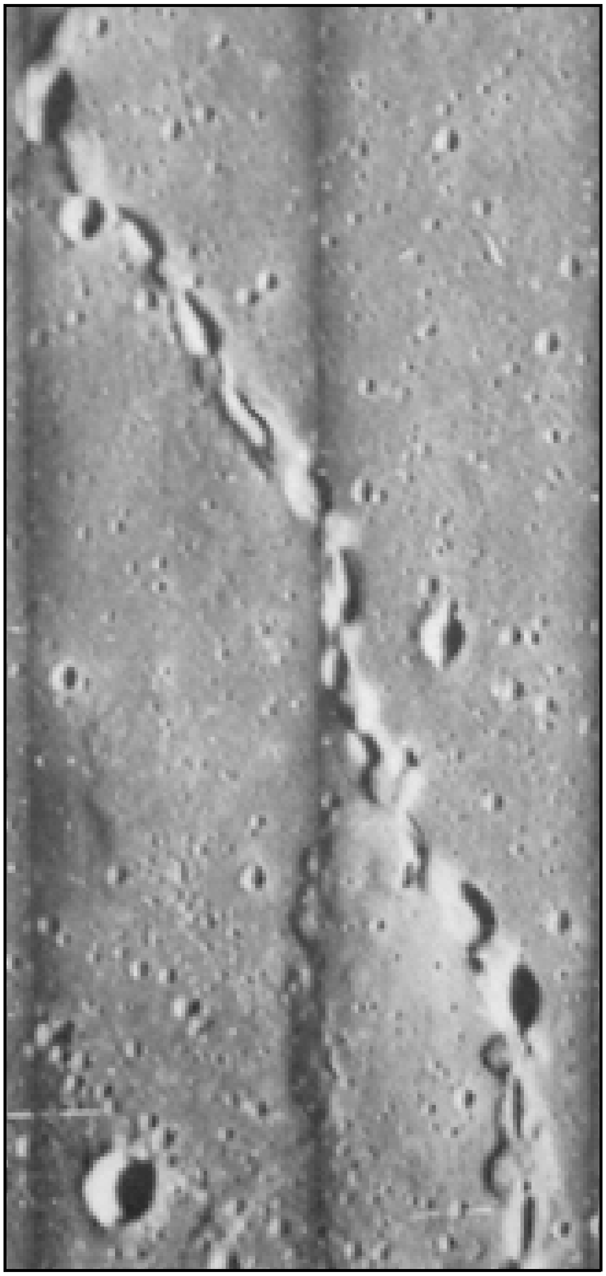

Figure 6: Lunar Orbiter 5, M-182; from *Wilhelms*.

less influenced by subsurface geologic structures. However, this rille is straight, and ends where the dome reaches the mare surface. Such a rille is likely due to tensional stresses, and these do show structural control by subsurface geology (e.g., a fault). Such tensional stresses are most consistent with laccolith formation.

Here the magma accumulating beneath the surface produced not only an upbowing of the surface rock layers, but also failure in the rock strata (fracturing). If these fractures remained only in the uppermost layers, then no magma would be released, and the fracture would remain sharply visible (once magma is released, these features become filled and/or smoothed). Note that it is possible for an effusive dome to have such a fracture, due to dike intrusion, but it is unlikely that a dike would terminate at both edges of the dome without extending onto the surrounding mare surface. Thus, we think that this structure is a laccolith.

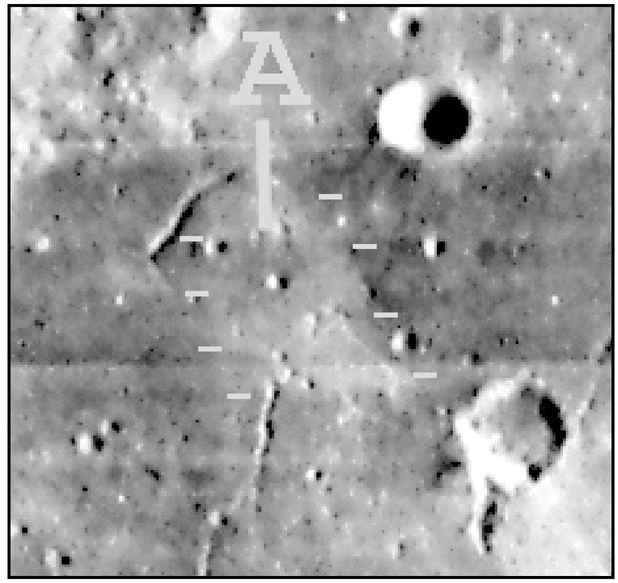


Figure 7: Lunar Orbiter 4, 114-H1

Next, it is of note that this dome has other rilles either on this dome or in its vicinity. The rille marked “C” (*Figure 3* and *Figure 4*) is clearly on the surface of the dome itself, but the exact nature of this rille is difficult to ascertain, given that it is near the resolution limit of the imagery.

The rille marked “D” (*Figure 3* and *Figure 4*) is difficult to place with respect to the dome, as the western edge of the dome is of small incline with respect to the surrounding surface (i.e., it doesn’t cast an observable western shadow at the sun angles observed), and it appears to intersect with a mare ridge (*Figure 5*, marked “E”). Our impression is that this rille is on the surface of the ridge, but not on the dome itself. The rille marked “B” (*Figure 3*, *Figure 4* and *Figure 5*) is clearly not on the dome, but on the ridge. This latter rille (“B”) appears to have scalloped edges, as if composed of multiple craterlets instead of being continuous (esp. see *Figure 3*).

Examples of “multiple craterlets” with a linear arrangement do appear on the Moon (*Figure 6*), and here the interpretation is that they are segments of a collapsed lava tube [*Wilhelms, 1987*]. Given the limits of the resolution of our imagery, and the advanced state of degradation of the structures, it is impossible to be sure of this interpretation here. Other possibilities include pits from eruptive degassing (possible), a fissure eruption (possible; for another possible example, see *Masursky, 1978*), and volcanic drainage pits (unlikely).

Next, there is another interesting feature in this section. Running through this region is a light section (marked in *Figure 7*), which is the bright ejecta from a distant impact. This light material covers the darker lava beneath. However, at a later time, a small impact struck within this lighter material, piercing this thin layer, and excavating the darker material beneath. This material was spread out in the small impact's ejecta, appearing as a dark halo crater (marked in *Figure 7 as "A"*). Note that this is a contrast-enhanced image, because erosion has decreased the contrast that was originally present, making it difficult to visually identify.

As a final comment, it is of note that the western edge of this structure is difficult to identify, given the low inclination of the structure with respect to the lunar surface. It is possible that the structure itself extends into the western/southern ridge. This would then be the manifestation of a sub-surface volcanic dike with sill formation (the extension of a non-viscous flow laterally between bedding planes; cf. *MacDonald, 1972*).

## Conclusion

Using the Westfall Classification Scheme (*Westfall, 1964*), we categorize the dome as DW/2a/5g/7n9n, or to explain it in detail — dome within a mare; 5-20 kilometers and circular, gentle profile with a flat summit (platykurtic), cross-dome depression (cleft or valley).

The lunar dome we have described here is another clear example of the elusive nature of these volcanic structures on the Moon and the need for more work in this challenging area.

Finally, international participation in our GLR dome project continues in a favorable response to our efforts to foster increased cooperation among lunar observers worldwide.

## Acknowledgement

Many thanks to Giorgio Di Iorio for his stimulating discussion.

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## A.L.P.O. LUNAR DOME SURVEY

Observation Form

Submit electronically (attach photographs and scanned drawings to e-mail) to:

***Marvin W. Huddleston*, F.R.A.S.**
kc5lei@comcast.net
or via mail:
2621 Spiceberry Lane
Mesquite, TX 75149-2954

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Observers Name:** | **Last:** | | | | | **First:** | | | | |
| **Date: (UD)** | **Month:** | | | **Day:** | | | **Year:** | | | |
| **Time: (UT)** | **(UT) Hours:** | | | | | **(UT) Minutes:** | | | | |
| **Colongitude:** | | | | | | | | | | |
| **Region Observed:** | | | | | | | | | | |
| **Telescope:** | **Size (Inches or Cm.):** | | | | | **Type:** | | | | |
| **Eyepieces Used:** | | | | | | | | **Filters:** | | |
| **Seeing (Circle)** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **Transparency:** | | | | | | | | | | |
| **Type of Observation (list details):** | **Visual:** | | | | | **Photographic:** | | | | |

**Domes Observed (Positions)**

| Xi | Eta | OR | Lunar Long. | Lunar Lat. |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Notes: (**Include Observer Location (City, State, and Country) Here**; Use back if necessary):

## Feature Story:
# A Report on the 1990-1991 Jupiter Apparition

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

## Abstract

Drift rates and wind speeds for over three dozen features on Jupiter are reported. Some of these features included a small dark spot near the Great Red Spot and a dark bar-like spot in the South Tropical Zone that had an oscillating longitude. A normalized magnitude of V (1,0) = -9.39 ± 0.02 was measured for Jupiter for June, 1991.

## Introduction

Three important developments occurred during the 1990-91 Jupiter apparition: 1) the release of the first Hubble Space Telescope images of Jupiter (*Sky & Telescope, 1991, 120-121*), 2) the revival of the south equatorial belt in mid-1990 (*Sky & Telescope, 1993, 78*), (*Olivarez, 1993, 76*), and 3) the successful imaging of $H_3^+$ aurora on Jupiter (*Sky & Telescope, 1992, 371*), (*Kim, 1991, 536*), (*Baron, 1991, 539*).

In addition to these developments, amateur astronomers kept a careful watch of Jupiter during 1990-91. Rogers *(1992)* summarized British observations of the giant planet. Schmude (*1993*) made B and V-filter magnitude measurements of Jupiter. Members of the Association of Lunar & Planetary Observers (ALPO) carried out hundreds of observations which are summarized in this report.

*Table 1* lists characteristics of the 1990-91 Jupiter apparition and *Table 2* lists the people who contributed observations. *Figure 1* shows the Jupiter nomenclature along with some typical drawings. The North Temperate Belt is abbreviated as the "NTB" and the southern boundary of the NEB is designated as "NEBs". *Figure 2* shows photographs of Jupiter, *Figure 3* shows close-up drawings and *Figure 4*, *Figure 5* and *Figure 6* show the longitudes of Jovian features along with drawings of the SEB.

West refers to the direction of increasing longitude. [Three longitudes are used for Jupiter: "System I" ($\lambda_I$) applies to the EZ, "System II" ($\lambda_{II}$) applies to most of the remaining areas and "System III" ($\lambda_{III}$) is the planet's underlying "radio" rotation period. Positive wind speeds are those that move from west to east (per John Rogers).

The planetographic latitude will be used throughout the report. All dates and times will be in Universal Time (UT).

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•Left-click your mouse on "*Figure*", "*Table*" or *reference citation* to jump to that particular item.

### Where is it Now

Jupiter is currently well-placed for all-night viewing high in the southern sky.

All observers are urged to participate in gathering and submitting observing reports to Mr. Schmude using the form at the end of this article.

Send all reports to: Richard Schmude, 109 Tyus St., Barnesville, GA 30204; e-mail to schmude@gdn.edu.

**Table 1: Characteristics of the 1990-91 Apparition of Jupiter***

| | |
|---|---|
| Opposition date | Jan. 29, 1991 |
| Equatorial diameter (arc-seconds) | 45.7 |
| Magnitude (at opposition) | -2.6 |
| Geocentric declination of Jupiter | 18.9º |
| Declination of the Sun (joviocentric) | 0.5º |
| Declination of the Earth (joviocentric) | 0.4º |
| *Data taken from the Astronomical Almanac (1990). | |

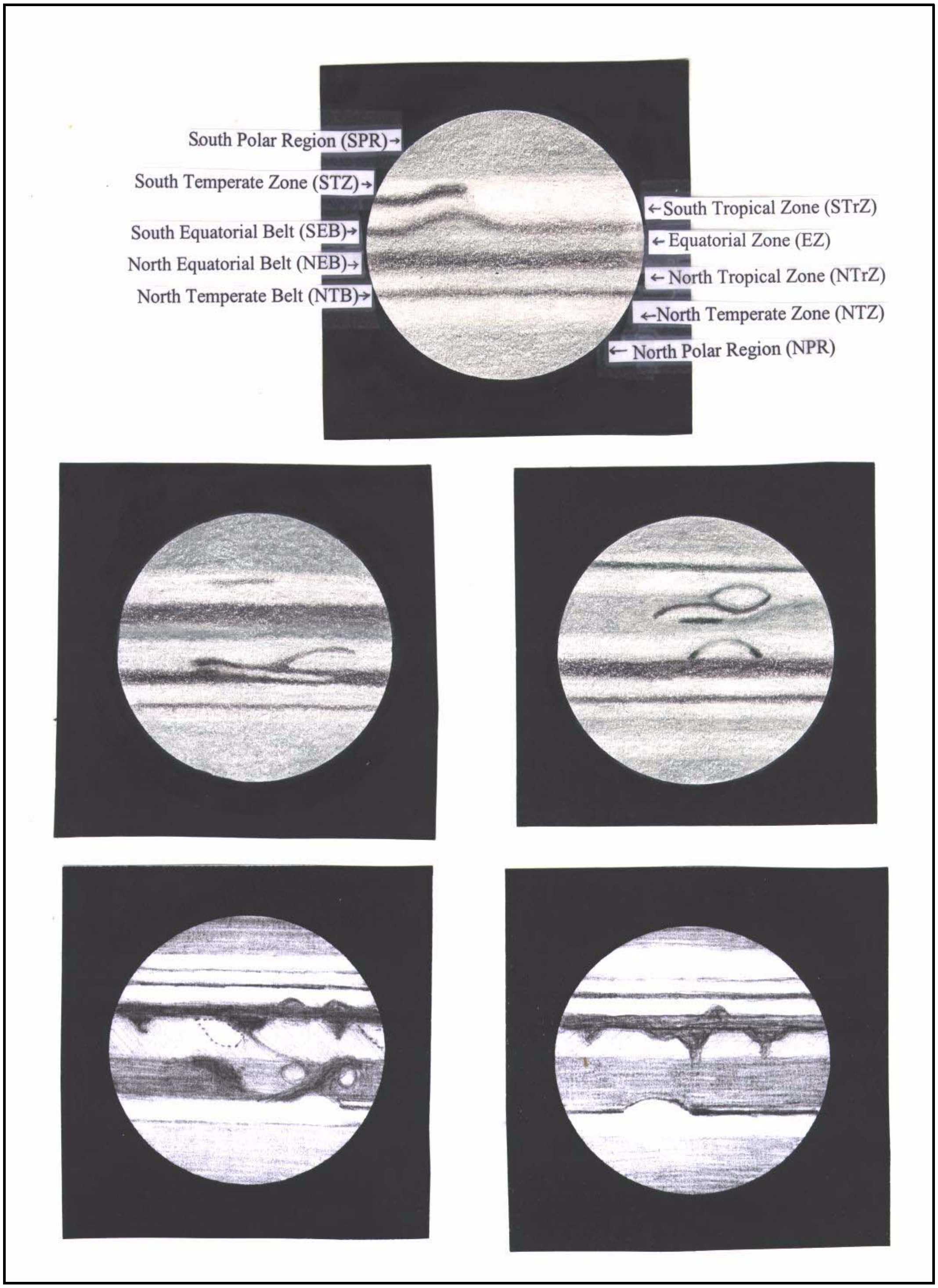


Figure 1. NOTE: The top 3 drawings show south at the top and the bottom 2 drawings show north at the top; the preceeding limb is at the left in all 5 drawings. Top center, drawing by Jose Olivarez, Aug 20, 1990 (11:10 UT) $\lambda_I$ = 247°, $\lambda_{II}$ = 46°, scope 0.32m (12.5-in.) reflector. Middle left, drawing by Craig MacDougal, Dec 12, 1990 (07:41 UT) $\lambda_I$ = 115°, $\lambda_{II}$ = 125°, scope 0.152m (6-in.) reflector. Middle right, drawing by Craig MacDougal, Dec 21, 1990 (07:01 UT) $\lambda_I$ = 73°, $\lambda_{II}$ = 15°, scope 0.152m (6-in.) reflector. Lower left, drawing by Elisabeth Siegel, Jan 31, 1991 (20:12 UT) $\lambda_I$ = 195°, $\lambda_{II}$ = 179°, scope 0.20m (8-in.) Schmidt-Cassegrain. Lower right, drawing by Elisabeth Siegel, April 10, 1991 (19:55 UT) $\lambda_I$ = 281°, $\lambda_{II}$ = 99°, scope 0.20m (8-in.) Schmidt-Cassegrain.

**Table 2: List of Contributors to this Apparition Report**

| Observer | Location | Instrument* | Type** |
|---|---|---|---|
| B. Adcock | View Bank, Australia | 0.31 m RL | TT |
| Claus Benninghoven | IA, USA | 0.30 m RR & 0.20 m RL | D, DN, SS, TT |
| Boulton[a] | Redditch, England | 0.16 m RL | DN |
| Mark Bousselaers | Berchem, Belgium | 0.13 m RR | TT |
| James R. Brunkella | Thousand Oaks, CA USA | 0.25 m RL | TT |
| S. Buda | View Bank, Australia | 0.31 m RL | TT |
| Phillip Budine | NY, USA | 0.09 m Mak & 0.10 m RR | R, SS, TT |
| Bennett Copeland | AZ, USA | 0.25 m RL | TT |
| David Graham[a] | N. Yorks, England | 0.15 m RR & 0.40 m RL | DN |
| Francis E. Graham | PA, USA | 0.24 m RR | P |
| David Gray[a] | Durham, England | 0.42 m RL | DN |
| Walter H. Haas | NM, USA | Several | DN, SS, TT |
| Alan W. Heath | Nottingham, England | 0.30 m RL | SS, TT |
| Yasunobu Higa | Okinawa, Japan | 0.25 m RL | SS |
| Andrew Johnson[a] | N. Yorks, England | 0.21 m RL | DN |
| Alfred Kruijsleep | Mt. Waverley, Australia | 0.20 m SC | TT |
| Barbara Lux | PA, USA | 0.10 m RR & 0.15 m RL | SS, TT |
| Craig MacDougal | FL, USA | 0.15 m RL | D, DN, TT |
| Isao Miyazaki | Okinawa, Japan | 0.41 m RL | P, SS |
| Woodie F. Morris | NJ, USA | 0.25 m RL | TT |
| Jose Olivarez | KS, USA | 0.32 m RL | D |
| Jim Park | Glen Waverley, Australia | 0.32 m RL | TT |
| Donald C. Parker | FL, USA | 0.41 m RL | P |
| Richard W. Schmude, Jr. | NM, USA | 0.25 m RL | SS, TT |
| Elisabeth Siegel | Denmark | 0.20 m SC | D, DN, TT |
| Paul Smith[a] | Darlington, England | 0.15 m RL | DN |
| Bob Talaga | AZ, USA | Several | TT |
| Randy Tatum | VA, USA | 0.18 m RR | DN, SS, TT |
| Daniel M. Troiani | IL, USA | 0.25 m RL | SS |
| Hendrik Vandenbrusene | Beernem, Belgium | 0.20 m RL | TT |
| Erwin Verwichte | Genk, Belgium | 0.15 m RL & 0.20 m RR | TT |
| Samuel R. Whitby | VA, USA | 0.15 m RL | D, DN, SS, TT |

[a] Location and telescope data were taken from Rogers (1992).
* Mak = Maksutov, RL = Reflector, RR = Refractor, SC = Schmidt-Cassegrain
** D = drawing, DN = descriptive notes, P = photographs, R = preliminary report, SS = strip sketch, TT = transit time

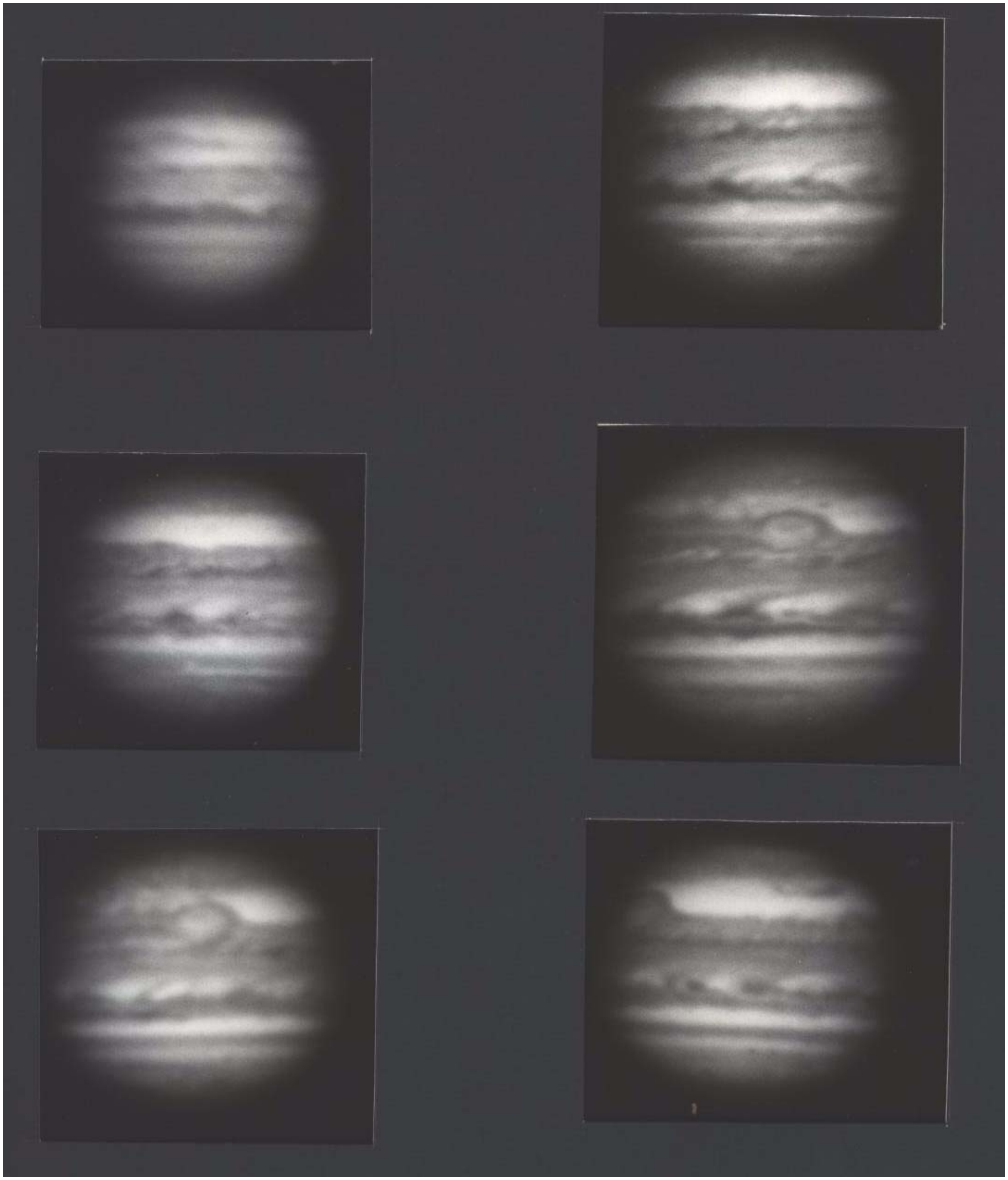

Figure 2. All photos by Donald C. Parker, using a 0.41m (16-in.) reflector in integrated light. Top left, Sept. 23, 1990 (9:22 UT) $\lambda_I$ = 145°, $\lambda_{II}$ = 45°; 2 seconds at f/93. Top right, Nov. 4, 1990 (10:01 UT) $\lambda_I$ = 318°, $\lambda_{II}$ = 258°; 2.5 seconds at f/93. Middle left, Nov. 26, 1990 (7:30 UT) $\lambda_I$ = 101°, $\lambda_{II}$ = 233°; 1.5 seconds at f/93. Middle right, Dec. 31, 1990 (05:31 UT) $\lambda_I$ = 157°, $\lambda_{II}$ = 23°; 2.0 seconds at f/93. Bottom left, Jan. 24, 1991 (05:23 UT) $\lambda_I$ = 346°, $\lambda_{II}$ = 29°; 2.5 seconds at f/93. Bottom right, Feb. 3, 1991 (05:02 UT) $\lambda_I$ = 114°, $\lambda_{II}$ = 81°; 1.5 seconds at f/93. The orientation of the images is the same as in Figure 1.

Several people made intensity estimates of the belts and zones. The relative intensity of the belts from darkest to lightest was NEB>SEBn=SEBs>NTB> GRS and the order of the zones from darkest to light-

**Table 3: Average Planetographic Latitudes of Belts on Jupiter***

| Belt | Planetographic latitude (integrated light) |
|---|---|
| NEBn | 19.0º±1ºN |
| NEBs | 8.7º±1ºN |
| EBc | 3.3º±0.5ºS |
| SEBn | 8.7º±1ºS |
| SEBs | 23.8º±1ºS |
| GRSc | 22.7º±0.5ºS |
| SSTBc | 43.2º±2ºS |
| SSSTBc | 48.6º±2ºS |

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

est was SEBz>NTZ>EZ>STrZ>NTrZ. According to notes by Benninghoven, the STrZ was brighter than the NTrZ on Nov. 22, 27 and Jan. 27, but from February through June, the NTrZ was brighter than the STrZ.

The author measured the planetographic latitudes of several belts from photographs; see *Table 3*. Latitudes for the SSTB and SSSTB were computed from position estimates made by Haas, while latitudes for the other belts were computed from measurements from images along with the formulae in Peek (*1981, 49*) and the sub-Earth longitudes were taken from the Astronomical Almanac (*1989, 1990*). The belt latitudes are consistent with historical values (*Rogers, 1995*).

The dimensions, areas and aspect values of several white ovals are listed in *Table 4*. The areas and aspects were measured in the same way as in Schmude (*2002, 26*).

## Region I: Great Red Spot

The GRS had a drift rate of 0.6°/30 days and a rotation rate of 9h 55m 42s; see *Figure 4*. The GRS was at: $\lambda_{II}$ = 32.8±0.4° at opposition. The average latitude of the GRS was 22.7° S, which is close to the historical value (*Rogers, 1995, 400*).

Talaga reported that the GRS had a faint pink interior on Dec. 10, Jan. 19 and Feb. 3; whereas Benninghoven reported several shades of yellow and orange for this feature between Jan. 7 and Mar. 30.

A series of drawings of the GRS is shown in *Figure 3*. Whitby reports that the GRS had an off-center bright area on Feb. 25. Similar features were also noted on Nov. 7, 1990 and Mar. 9, 1991.

Whitby reported that there was an intensely dark spot on the northern edge of the GRS on Oct. 7; see *Figure 3*. He stated that this spot was similar to a satellite shadow. This same, dark feature may have been seen on Oct. 24 and 31 by Whitby.

During August and September, 1990 The GRS lacked a northwest border and it appeared to merge with surrounding white areas; see *Figure 1* and *Figure 2*. The GRS had a similar appearance in 1928 (*Rogers, 1995, 190*). By early October, a complete, dark ring surrounded the GRS; see *Figure 3*. Whitby drew a bright oval (probably FA) just south of the following edge of the GRS. According to the drift rates

**Table 4: Dimensions of White Ovals During the 1990-91 Apparition***

| Feature | Dimension (km) | | Aspect | Area ($\times 10^6$ km$^2$) |
|---|---|---|---|---|
| | East-West | North-South | | |
| B1 | 7500 | 6100 | 0.81 | 36 |
| B2 | 5300 | 4700 | 0.89 | 20 |
| B3 | 7800 | 5100 | 0.65 | 31 |
| B4[a] | 6200 | 5300 | 0.86 | 26 |
| Oval BC | 9300 | 8000 | 0.85 | 59 |
| Oval DE | 9000 | 6400 | 0.71 | 45 |
| Oval FA | 6300 | 4800 | 0.77 | 24 |
| C1 | 9600 | 6700 | 0.69 | 51 |
| C2 | 5600 | 3900 | 0.69 | 17 |
| C3 | 5500 | 2600 | 0.47 | 11 |
| H1 | 6600 | 6600 | 1.00 | 34 |

*The aspect ratio is the north-south dimension divided by the east-west dimension. All areas were computed by assuming an elliptical shape for each feature. All east-west and north-south dimensions have uncertainties of 750 km

[a]There were not enough data to compute a drift rate for this feature; B4 was at $\lambda_{II}$ = 190º on Jan. 30, 1991

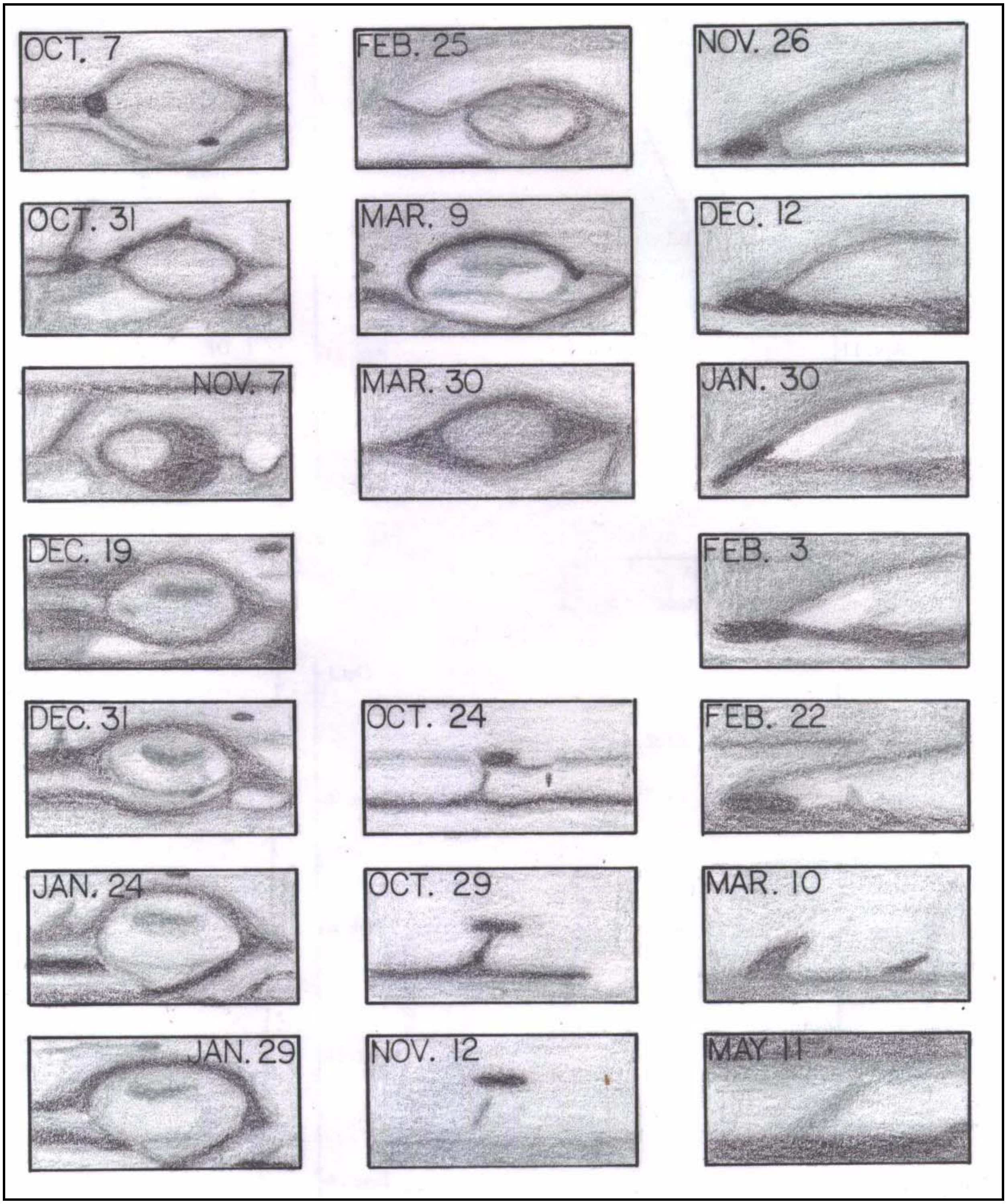


Figure 3. Drawings of the GRS (left column and the top half of the center column), the STB oscillating spot – C4 (bottom 3 frames of the middle column), and festoon E3 (right column). The orientation of the images is the same as in Figure 1.

**Table 5: Drift Rates of Various Features During the 1990-91 Apparition**

| I.D. | Number of points | Time Interval | Planetographic Latitude | Drift Rate (deg./30 days) System II | Rotation Rate |
|---|---|---|---|---|---|
| *South South South South Temperate Current* | | | | | |
| A1 | 2 | Jan. 24-29 | ~55ºS | -27.6 | 9h 55m 03s |
| *South South Temperate Current* | | | | | |
| B1 | 20 | Oct. 28 - Mar. 15 | ~43ºS | -30.1 | 9h 55m 00s |
| B2 | 7 | Dec. 19 – Mar. 7 | ~44ºS | -25.2 | 9h 55m 06s |
| B3 | 7 | Dec. 19 – Mar. 10 | ~44ºS | -25.9 | 9h 55m 05s |
| Average | | | 44ºS | -27.1 | 9h 55m 04s |
| *South Temperate Current* | | | | | |
| Oval FA | 11 | Feb. 3 – May 27 | ~35ºS | -12.0 | 9h 55m 24s |
| Oval BC | 11 | Jan. 12 – Apr. 4 | ~34ºS | -10.7 | 9h 55m 26s |
| Oval DE | 13 | Dec. 13 – Mar. 30 | ~34ºS | -10.0 | 9h 55m 27s |
| C1 | 8 | Dec. 13 – Mar. 10 | ~31ºS | -9.6 | 9h 55m 28s |
| C3 | 5 | Dec. 19 – Jan. 29 | ~33ºS | -16.3 | 9h 55m 18s |
| C4 | 9 | Sep. 28 – Nov. 22 | ~33ºS | -11.4 | 9h 55m 25s |
| Average | | | 33ºS | -11.7 | 9h 55m 25s |
| *South Tropical Current* | | | | | |
| GRS | 110 | Sep. 23 – July 2 | 22.7ºS | 0.6 | 9h 55m 42s |
| C2 | 7 | Jan. 23 – Mar. 15 | ~23ºS | 9.0 | 9h 55m 53s |
| *North Tropical Current ( projections and barges)* | | | | | |
| N1 | 38 | Dec. 10 – June 27 | 19ºN | -2.5 | 9h 55m 37s |
| N2 | 5 | Jan. 12 – Feb. 5 | 19ºN | -4.2 | 9h 55m 35s |
| N3 | 23 | Feb. 5 – May 17 | 19ºN | -0.2 | 9h 55m 40s |
| N5 | 16 | Feb. 17 – Apr. 27 | 19ºN | -2.1 | 9h 55m 38s |
| N6 | 14 | Feb. 7 – Apr. 29 | 19ºN | -2.6 | 9h 55m 37s |
| N9 | 5 | Mar. 6 – Apr. 11 | 19ºN | 2.3 | 9h 55m 44s |
| Average | | | 19ºN | -1.5 | 9h 55m 39s |
| *North Tropical Current (ovals)* | | | | | |
| N4 | 4 | Feb. 23 – Mar. 15 | 19ºN | -1.2 | 9h 55m 39s |
| N7 | 5 | Feb. 24 – Mar. 20 | 19ºN | -13.4 | 9h 55m 22s |
| N8 | 8 | Feb. 26 – May 12 | 19ºN | -1.1 | 9h 55m 39s |
| N10 | 4 | Apr. 11 – Apr. 28 | 19ºN | 7.6 | 9h 55m 51s |
| Average | | | 19ºN | -2.0 | 9h 55m 38s |
| *North Temperate Current* | | | | | |
| G1 | 4 | May 12 – June 8 | ~33ºN | 12.9 | 9h 55m 58s |
| G2 | 5 | Feb. 7 – Mar. 1 | ~33ºN | 7.8 | 9h 55m 51s |
| G3 | 6 | May 5 – June 15 | ~33ºN | 13.3 | 9h 55m 59s |
| Average | | | 33ºN | 11.3 | 9h 55m 56s |
| *North North North Temperate Current* | | | | | |
| H1 | 2 | Jan. 24 – Jan. 29 | ~50ºN | 12.0 | 9h 55m 57s |

in *Table 5*, oval FA passed the center of the GRS around July 2, whereas in the data published by Rogers *(1992, 332)*, suggest that the transit date was June 18.

## Region II: South Polar Region to the South Tropical Zone

The author analyzed 34 red, blue and integrated light photographs using the same procedure outlined in Schmude (*2003a*) and found that the NPR and SPR had nearly equal light intensities and colors. Whitby reported that the NPR was dark on May 4, 5 and 11, 1991.

A white oval (A1) at 55°S was at system II longitudes of 7.9° W (Jan. 24) and 3.3° W (Jan. 29), which is consistent with a drift rate of -27.6°/30 days.

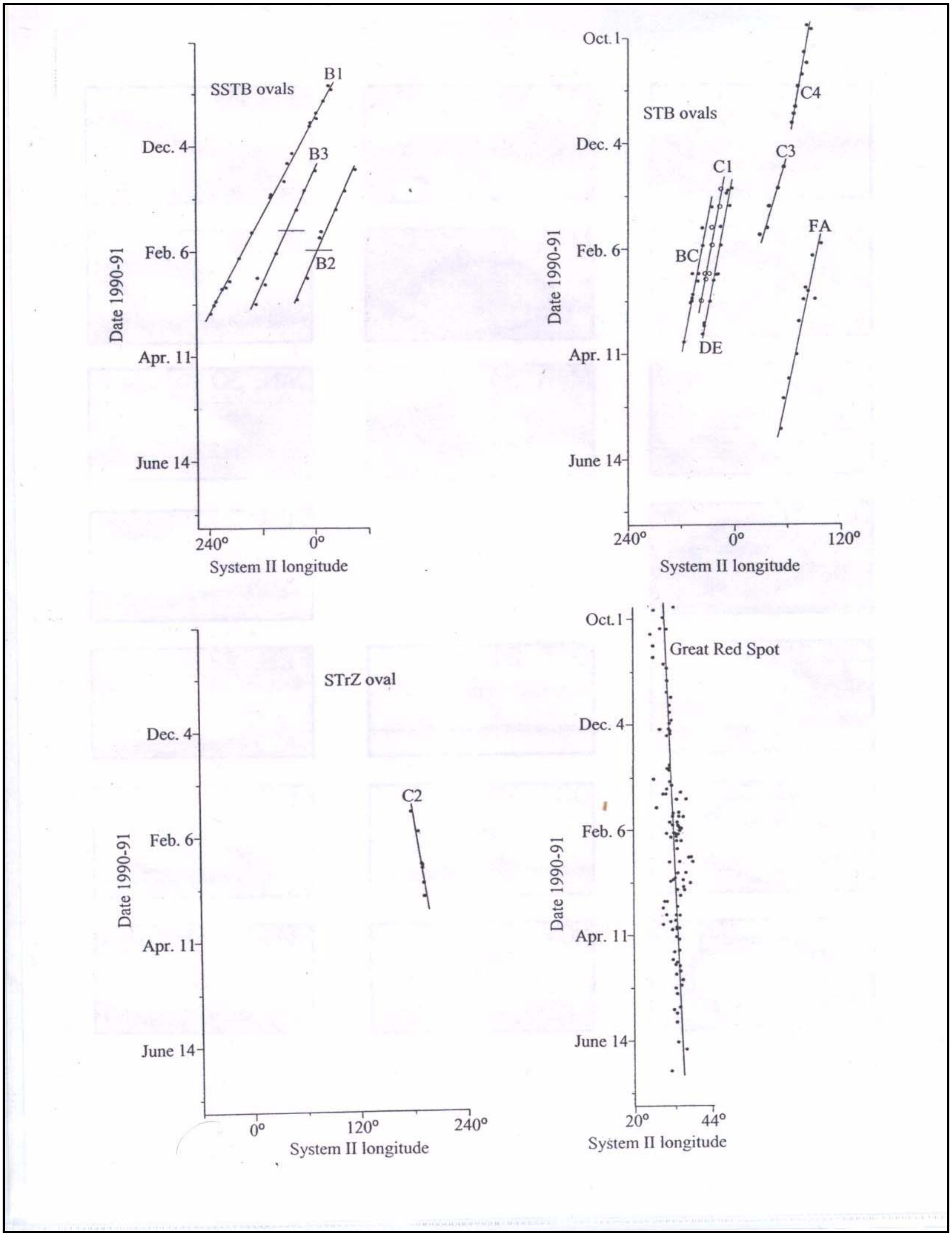


Figure 4. Longitudes for features in the SSTB and the STrZ. Open and closed cicles are longitudes determined from photographs or transit times and lines are longitudes measured from drawings.

**Table 6: Drift Rates of Features in the Equatorial Zone, 1990-91 Apparition**

| *Equatorial Current (Festoons)* | | | | | |
|---|---|---|---|---|---|
| **I.D.** | **Number of points** | **Time Interval** | **Planetographic Latitude** | **Drift Rate (deg./30 days) System I** | **Rotation Rate** |
| E1 | 6 | Sep. 9 – Oct. 16 | 8.7ºN | 4.1 | 9h 50m 36s |
| E2 | 7 | Sep. 19 – Oct. 28 | 8.7ºN | -0.1 | 9h 50m 30s |
| E3 | 41 | Nov. 21 – May 26 | 8.7ºN | 0.2 | 9h 50m 30s |
| E4 | 31 | Feb. 5 – June 18 | 8.7ºN | 0.7 | 9h 50m 31s |
| E5 | 34 | Oct. 28 – Apr. 3 | 8.7ºN | 1.0 | 9h 50m 31s |
| E6 | 9 | Sep. 4 – Oct. 31 | 8.7ºN | -2.8 | 9h 50m 26s |
| E7 | 21 | Jan. 24 – Apr. 21 | 8.7ºN | 0.6 | 9h 50m 31s |
| E8 | 10 | Nov. 26 – Jan. 16 | 8.7ºN | 1.1 | 9h 50m 31s |
| E8A | 6 | Sep. 9 – Oct. 13 | 8.7ºN | 3.8 | 9h 50m 35s |
| E9 | 7 | Sep. 22 – Oct. 31 | 8.7ºN | -1.8 | 9h 50m 28s |
| E9A | 6 | Nov. 25 – Jan. 2 | 8.7ºN | 0.6 | 9h 50m 31s |
| E10 | 28 | Jan. 7 – May 3 | 8.7ºN | 0.2 | 9h 50m 30s |
| E11 | 8 | Jan. 26 – Mar. 17 | 8.7ºN | 2.9 | 9h 50m 34s |
| E12 | 8 | Jan. 28 – Mar. 15 | 8.7ºN | 6.8 | 9h 50m 39s |
| Average | | | 8.7ºN | 1.2 | 9h 50m 32s |

The SSTB ovals B1, B2 and B3 had an average drift rate of -27.1°/30 days, which is close to similar features in 1987-90 (*Schmude, 2003b, 47-48*), (*Lehman et al. 1999, 54*).

Oval B2 passed the GRS on about Jan. 2, 1991. This passage may have affected the January drift rate of B2; see *Figure 4*.

Six features in the South Temperate Current: four white ovals (C1, BC, DE and FA) and two dark spots (C2 and C4) had an average drift rate of -11.7°/30 days, which is close to the 1987-90 rates (-9.5° to -11.6°/30 days) (*Lehman et al. 1999, 54*), (*Schmude, 2003b, 47-48*).

Feature C3 was a small dark spot near the GRS and it was similar to the 1998 STrZ dark spot, which had dimensions of 4500 km (east-west) by 3500 km (north-south) and an area of 12 x $10^6$ $km^2$. The 1998 spot had a drift rate of -15°/30 days between July 14, 1998 and Feb. 21, 1999, which is similar to C3 (-16.3°/30 days).

Feature C4 was a dark barge; see *Figure 3* (bottom 3 frames in middle column). Budine pointed out that C4 had an oscillating longitude (*Budine, 1991*); see *Figure 4*. The amplitude of the oscillation was ~3° with a period of 17 days. The amplitude and period are similar to those of the 1987 oscillating spot (Budine, 1988, 15), (*Schmude, 2003b, 46*) but are about half of the corresponding values of the 1940-41 oscillating spot described by Peek (*1981, 186*).

White oval C2 had a dark outer ring on Jan. 30 and Feb. 23. Both Whitby and Benninghoven described this oval as being “intensely bright”.

## Region III: South Equatorial Belt

The SEB darkened during late 1990 and this is shown in *Figure 5* (Dec. 15-19 frame). Due to the rapid changes in the SEB, I was unable to compute drift rates of features in this belt.

Siegel and Talaga reported a reddish-brown to orange-brown color for the SEB on several dates between Oct. 15, 1990 and Mar. 10, 1991. Benning-

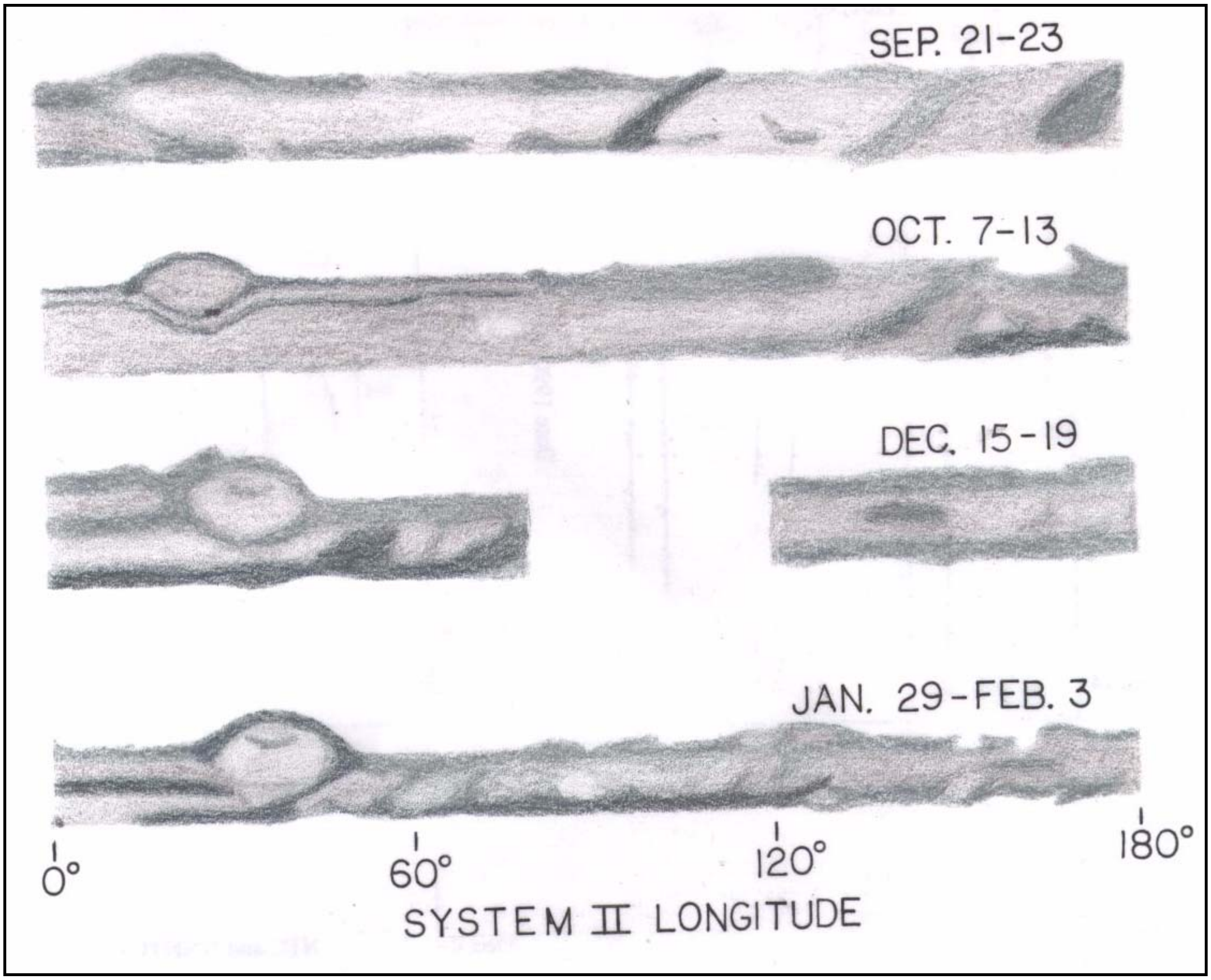


Figure 5. Drawings of the SEB made from photographs and drawings.

hoven reported a gray color for the SEBs on several dates between Feb. 25 and Mar. 20 whereas he reported a brown or orange color for the SEBn during this time.

On Feb. 13, Benninghoven wrote "The impression of a single very wide belt in the center of the planet is very strange with the EZs and SEBn being the darkest part." Benninghoven made his observations between 3:30 and 4:32 UT and his observation is confirmed in a photograph taken by Parker on Feb. 3; see *Figure 2* (bottom right image).

## Region IV: Equatorial Zone

Almost all of the festoons in *Figure 6* lasted for 6 weeks or more, which is similar to the festoons in the 1991-92 and 1992-93 apparitions. The average drift rate for the 1990-91 festoons was 1.2°/30 days (system I longitude), which is close to the 1991-92 (0.9°/30 days) and the 1992-93 (0.3°/30 days) drift rates.

Benninghoven, Siegel and Talaga all reported colors for the EZ ranging from pink to yellow to brown from Sep. 1990 to April 1991. The EZ apparently underwent a major coloration event right after the SEB revival. An SEB revival is an event where the SEB reappears after being almost invisible. Rogers (*1995, 149*) reports that EZ coloration events often occur at about the same time as SEB revivals and so the 1990-91 events are consistent with historical records.

The EZs was darker in blue light photographs than in red light photographs on Nov. 4, 26, Dec. 19, 31 and Jan. 30. These results are consistent with the color observations made by Benninghoven, Siegel and Talaga.

There was often a bright area at the western edge of the base of E3 (for example, Jan. 30 in *Figure 3*), which may be clouds that dissipate once they reach the festoon (*Showman and Dowling, 2000, 1739*).

**Table 7: Average Drift Rates, Rotation Periods and Wind Speeds for Several Currents on Jupiter, 1990 - 91 Apparition**

| Current | Feature | Drift Rate (degrees/30 days) | | | Rotation Period | Wind Speed (meter/sec.)[a] |
|---|---|---|---|---|---|---|
| | | Sys. I | Sys. II | Sys. III | | |
| SSSS Temp. Cur. | A1 | 201.3 | -27.6 | -19.6 | 9h 55m 03s | 5.6±4[b] |
| SS Temp. Cur. | B1-B3 | 201.8 | -27.1 | -19.1 | 9h 55m 04s | 6.8±0.5 |
| S Temp. Cur | C1,C3,C4,Ovals FA, BC,DE | 217.2 | -11.7 | -3.7 | 9h 55m 26s | 1.5±0.5 |
| S Trop. Cur | GRS | 229.5 | 0.6 | 8.6 | 9h 55m 42s | -3.9±0.2[b] |
| S Trop. Cur | C2 | 237.9 | 9.0 | 17.0 | 9h 55m 53s | -7.6±0.5[b] |
| Eq. Cur. (festoons) | E1-E12 | 1.2 | -227.7 | -219.7 | 9h 50m 32s | 104.6±0.4 |
| N Trop. Cur. (rods and projections) | N1-N3,N5,N6,N9 | 227.4 | -1.5 | 6.5 | 9h 55m 39s | -3.0±0.5 |
| N Trop. Cur. (ovals) | N4,N7,N8,N10 | 226.9 | -2.0 | 6.0 | 9h 55m 38s | -2.7±1.7 |
| N Temp. Cur. | G1-G3 | 240.2 | 11.3 | 19.3 | 9h 55m 56s | -7.9±0.6 |
| NNN Temp. Cur. | H1 | 240.9 | 12.0 | 20.0 | 9h 55m 57s | -6.4±4.0[b] |

[a] Measured with respect to the System III longitude
[b] Estimated uncertainties

## Region V: North Equatorial Belt

There were several barges (or projections) on the NEBn (features N1-N3, N5, N6, and N9). The mean drift rate (system II longitude) for all features was -1.5°/30 days, which is close to the corresponding rates in 2001-02 (-2.5°/30 days) and 2002-03 (-3.2°/30 days) (*Schmude, 2003a*, and *2003c*).

Four ovals (N4, N7, N8 and N10) in the NEB had an average drift rate of -2.0°/30 days, which differs from the corresponding rates in 2001-02 (-5.8°/30 days) and 2002-03 (-12.2°/30 days) (*Schmude, 2003 a*, and *2003c*).

The NEB was darker in blue light photographs than red light photographs on Nov. 4, 26, Dec. 19, 31 and Jan. 30; this is consistent with a reddish color. Talaga, however, reported a blue or purple color for the NEBn on Oct. 15, Dec. 31 and Jan. 14. Similarly, Benninghoven reported a purple color for the NEB on Jan. 4 and Mar. 15. It is possible that the EZ coloration affected the perceived appearance of the NEB.

Benninghoven reported a very bright rift in the NEB on Dec. 8, 1990. This rift's preceding edge was at $\lambda_I = 342°$. Whitby also reported a wide rift cutting completely through the NEB on Oct. 31 at $\lambda_I = 30°$.

## Region VI: North Tropical Zone to the North Polar Region

Two bright ovals (G1 and G3) and a dark rod (G2) were in the north temperate current; their average drift rate was 11.3°/30 days (system II longitude).

Both Whitby and MacDougal reported that the NTB appeared double near $\lambda_{II} = 20°$ in early 1991. Whitby noted that the NTB had a knotty appearance on April 16 and June 11. Whitby and MacDougal also noted that the NTB appeared to be broken into pieces in March. Whitby drew the NTB as weak on June 3 ($\lambda_{II} = 320°$) and June 16 ($\lambda_{II} = 110°$) but drew it dark on June 11 ($\lambda_{II} = 80°$) and June 25 ($\lambda_{II} = 10°$).

Whitby (Nov. 21) and MacDougal (Nov. 27) independently observed a darker section of the NNTB beginning at $\lambda_{II} = 340°$ and extending westward.

A single white oval (H1) near 50° N was photographed on Jan. 24 and Jan. 29. This oval was a bit brighter in red light than in integrated light. This feature had a drift rate of ~12°/30 days.

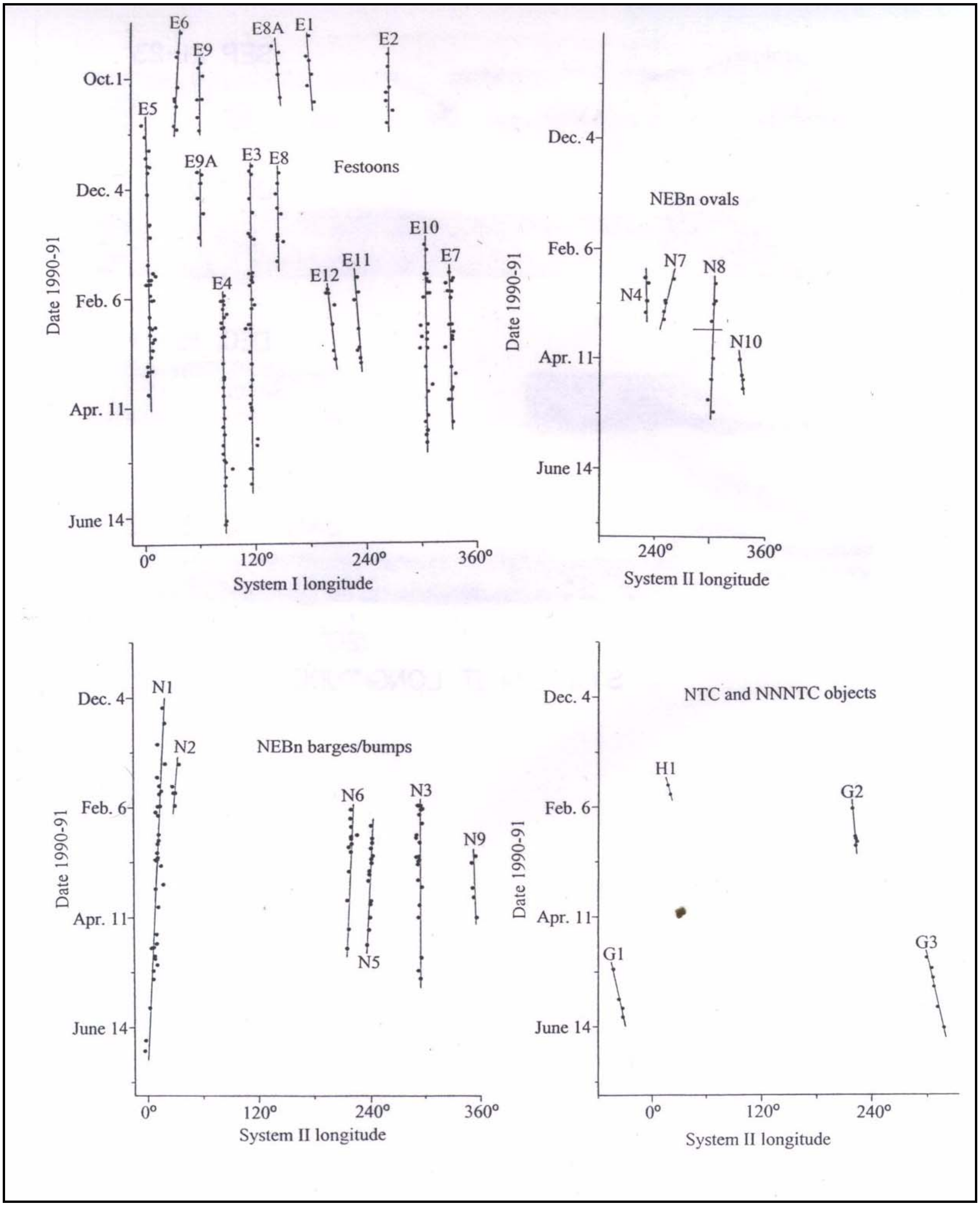


Figure 6. Longitudes for features between the EZ and the NNNTC; symbols as in Figure 4.

## Satellites

Westfall (*1994*) published results of the Galilean satellite eclipse timings for the 1990-91 apparition.

## Wind Speeds

*Table 5* and *Table 6* summarize the drift rates for the 1990-91 apparition and *Table 7* summarizes wind speeds. The wind speeds are close to the historical values (*Peek*, 1981), (*Rogers, 1995*) except for possibly the NNN temperate current.

Most of the longitudes were determined from estimated transit times. In a few cases longitudes were measured from drawings or photographs with a device described by Rogers (*1995, 391*). The wind speeds were computed in the same way as in Rogers (*1995, 392*). Uncertainties in the wind speeds were computed in the same way as in Schmude (*2003a, 50*).

## Photometry

Schmude (*1993, 135*) reported V-filter magnitudes for Jupiter in June, 1991; however no color corrections were made for these measurements. Color corrections were added to the 1991 measurements and a normalized magnitude of V(1,0) = -9.39 ± 0.02 is selected for Jupiter during June, 1991.

## Acknowledgements

The writer would like to thank Don Parker and Elisabeth Siegel for sending duplicate sets of observations. I would also like to thank everyone who sent in observations during 1990-91.

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## Feature Story: The Remote Planets

# The Uranus, Neptune and Pluto Apparitions in 2003

By: Richard W. Schmude, Jr., coordinator
ALPO Remote Planets Section
E-mail to schmude@gdn.edu

## Abstract

For 2003, the selected normalized magnitudes for Uranus are B(1,0) = -6.59 ± 0.03 and V(1,0) = -7.12 ± 0.01; the corresponding values for Neptune are B(1,0) = -6.64 ± 0.02 and V(1,0) = -6.99 ± 0.01; and that for Pluto is V(1,0) = -1.20 ± 0.20. The data show that Uranus continued to fade in 2003 whereas Neptune has maintained a nearly constant brightness.

## Introduction

Professional astronomers published several important remote planets papers in 2003. Hofstadter and Butler (2003), for example, compared their recent microwave measurements to those made in the 1960s, 1970s and 1980s and discovered that Uranus probably underwent seasonal changes in brightness. Essentially Hofstadter and Butler stated that Uranian south polar latitudes emitted more microwave energy than did the south temperate latitudes during the last third of the 20th century.

In a second study, Gibbard and co-workers (2003) discovered three distinct cloud bands on Neptune using a near-infrared camera attached to the W. M. Keck II telescope. They suggested that one of the cloud bands, at latitudes between 30°S to 50°S, is made up of methane. Gibbard and co-workers also stated that clouds in Neptune's northern hemisphere are at higher altitudes than those in the southern hemisphere.

In a third study, Olkin, Wasserman and Franz (2003) used recent Hubble Space Telescope images of Pluto to measure the wobble of that planet as Charon moved in its orbit. By measuring Pluto's wobble, they were able to compute densities, in grams per cubic centimeter, of 1.8 - 2.1 for Pluto and 1.6 - 1.8 for Charon; they went on to show that Pluto and Charon contain more rock than what is expected in the outer solar system. Finally, Kavelaars and co-workers (2004) reported the discovery of four new moons around Uranus.

In addition to the previous professional accomplishments, members of the Association of Lunar & Planetary Observers (ALPO) also carried out valuable studies of the remote planets in 2003. This paper summarizes these studies. *Table 1* lists the names, locations and other information about the people who submitted remote-planets observations in 2003-04, while *Table 2* lists summary data for Uranus, Neptune and Pluto during their 2003 apparitions.

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## Photoelectric Photometry

Calia, Fox, Schmude and Westfall used SSP-3 solid-state photometers, along with filters that were transformed to the Johnson B and V system, in making their photometric measurements. The SSP-3 photometer is described elsewhere (Schmude, 1992, 20; Optec, 1997). West used a CCD camera along with a V-filter to measure the brightness of Uranus and Pluto + Charon (hereafter called "Pluto").

*Table 3* lists characteristics of the comparison and check stars used for Uranus, Neptune and Pluto. *Tables 4*, *5* and *6* list magnitude measurements of Uranus, Neptune and Pluto. All measurements of Uranus and Neptune were corrected for both atmospheric extinction and transformation. Magnitudes of the check stars matched up well with literature values except in one case; the measured B-filter magnitude of 38 Aqr was 5.41, which is higher than the literature value of 5.34 (Iriarte *et al*., 1965). One possible reason for this discrepancy was the large color difference between the comparison star 50 Aqr and 38 Aqr.

Since the magnitude measurements of Pluto were made with a CCD camera, the extinction corrections are negligible because the planet and the comparison star were so close to each other. The Pluto magni-

**Table 1: Contributors of Remote Planet Observations in 2003-04**

| Name | Location | Telescope[a] | Type of Observation[b] |
|---|---|---|---|
| Patrick Abbott | Alberta, Canada | 8x42 & 10x50 Bin. | VP |
| Michael Amato | CT, USA | 0.15-m RL | C |
| John Bannen | Pacifica, CA, USA | 0.36-m SC | D, DN |
| Ron Bhanukitsiri | San Diego, CA, USA | 0.10-m RR | D |
| Norman Boisclair | NY, USA | 0.51-m RL | C, DN |
| Tom Buchanan | GA, USA | Spectroscope | S |
| C. Laird Calia | CT, USA | 0.13-m MC | C, PP |
| Rolando Chavez | GA, USA | 0.30-m camera lens | I |
| Brian Cudnik | Several locations in TX, USA | Several | C, DN, VP |
| Jim Fox | MN, USA | 0.25-m SC | PP |
| Robin Gray | NV, USA | 11x80 Bin & 0.15-m RR | C, DN, VP |
| Walter Haas | NM, USA | 7x35 Bin & 0.32-m RL | DN, VP |
| Jason Hatton | Simi Valley, CA USA | 0.23-m SC | I |
| Rik Hill | AZ, USA | 0.76-m S | I |
| Brian Loader | Darfield, New Zealand | 0.25-m SC | PP |
| Paul Maxson | AZ, USA | 0.20-m SC | I |
| Frank Melillo | NY, USA | — | DN |
| Larry Owens | GA, USA | 0.36-m SC | I |
| Philip Plante | OH, USA | 0.08-m RR | C, DN, VP |
| Richard Schmude, Jr. | GA, USA | Several | C, PP, VP |
| Ignasi Tobal | Avila and Barcelona, Spain | 0.26-m C | D |
| Tòfol Tobal | Avila and Barcelona, Spain | 0.15-m RR | D, VP |
| Roger Venable | GA, USA | 0.28-m SC & 0.40-m RL | DN |
| Doug West | KS, USA | 0.20-m & 0.25-m SC | PP |
| John Westfall | Antioch, CA USA | 0.36-m SC | PP |

[a] Bin = Binoculars, C = Cassegrain, MC = Maksutov-Cassegrain, RL = reflector, RR = refractor, S = Schmidt, CS = Schmidt-Cassegrain.

[b]C = color, D = drawings, DN = descriptive notes, I = CCD or video images, PP = photoelectric photometry, S = spectra, VP = visual photometry.

**Table 2: Characteristics of the 2003 Apparitions of Uranus, Neptune and Pluto (Data are from the *Astronomical Almanac* for the years 2002-2004)**

| Parameter | Uranus | Neptune | Pluto |
|---|---|---|---|
| First Conjunction Date | 2003 Feb. 17 | 2003 Jan. 31 | 2002 Dec. 09 |
| Opposition Date | 2003 Aug. 24 | 2003 Aug. 04 | 2003 June 09 |
| Angular Diameter (opposition) | 3.7 arc-sec. | 2.4 arc-sec. | 0.11 arc-sec. |
| Right Ascension (opposition) | 22h 13m | 20h 57m | 17h 14m |
| Declination (opposition) | -11°.9 | -17°.3 | -13°.4 |
| Second Conjunction Date | 2004 Feb. 22 | 2004 Feb. 2 | 2003 Dec. 12 |

**Table 3: Comparison and Check Stars Used in Photoelectric Magnitude Measurements of Uranus and Neptune in 2003**

| Star Name | Right Ascension | Declination (degrees) | B-filter Magnitude | V-filter Magnitude |
|---|---|---|---|---|
| 50 Aqr[a] | 22h 24.5m | -13.53 | 6.73 | 5.76 |
| 38 Aqr[a] | 22h 10.6m | -11.57 | 5.34 | 5.46 |
| Iota Aqr[b] | 22h 06.4m | -13.87 | 4.18 | 4.25 |
| Gamma Aqr[b] | 22h 21.7m | -1.39 | 3.80 | 3.85 |
| Mu Cap[a] | 21h 53.3m | -13.55 | 5.45 | 5.08 |
| Gamma Cap[b] | 21h 40.1m | -16.66 | 3.99 | 3.67 |
| Rho Cap[b] | 20h 28.9m | -17.81 | 5.18 | 4.80 |
| Theta Cap[b] | 21h 05.9m | -17.23 | 4.06 | 4.07 |
| 19 Cap[a] | 20h 54.8m | -17.92 | 6.90 | 5.78 |
| SAO 163973[c] | 20h 54.8m | -18.79 | 6.66 | 6.957 |
| Alpha Del[b] | 20h 39.6m | +15.91 | 3.72 | 3.77 |
| TYC 5657 366[c] | 17h 19.5m | -13.79 | ---- | 10.69 |
| TYC 5657 308[c] | 17h 19.7m | -13.81 | ---- | 11.55 |

[a]All data are from Hirshfeld et al. (1991)

[b]The right ascension and declination are from Hirshfeld et al. (1991) and the magnitude data are from Iriarte et al. (1965). This star was used for color comparison only.

[c] Right ascension and declination and magnitude data from Tycho 2 catalog, magnitudes corrected to Johnson V magnitudes using the formulae on the web page: http://hometown.aol.com/dwest61506/page32.html

tudes were not corrected for color transformation; however, this correction was usually less than 0.02 magnitudes for previous Pluto measurements made by West.

The selected normalized magnitudes are listed in *Table 7*. (The normalized magnitude is the magnitude that a planet would have if it were 1.0 astronomical unit from both the Earth and Sun and at a solar phase angle of 0°.) The normalized magnitude was computed in the same way as is described in Schmude (2000).

The mean normalized magnitude of Uranus is 0.02 magnitudes fainter than it was in 2000 (Schmude, 2001, 30), which indicates that Uranus is continuing to get dimmer. Neptune's magnitude has remained about the same during the last 3-4 years.

Calia reported six V-filter magnitude measurements of Uranus. These measurements were not corrected for color transformation and thus could not be included in *Table 4*. The mean normalized magnitude of Uranus based on these six measurements is V(1,0) = -7.14 ± 0.02, which is close to the selected value.

The mean normalized magnitude of Pluto from *Table 6* is V(1,0) = -1.20 ± 0.20. A solar phase angle coefficient of 0.041 ± 0.003 magnitudes/degree (Binzel and Mulholland, 1984, 1759) was used in computing the normalized magnitude. The writer believes that the value from *Table 6* is close to the actual mean value for Pluto because the measures cover a wide range of longitudes. The 2003 value is much brighter than the 2001 value of V(1,0) = -0.93 ± 0.10, although the difference of 0.27 magnitudes is actually not statistically significant.

## Visual Magnitude Estimates

Seven observers made 134 visual magnitude estimates of Uranus and 53 estimates of Neptune during 2003-04. The mean normalized magnitudes based on these estimates are: $V_{vis}(1,0)$ = -7.1 ± 0.01 (Ura-

**Table 4: Photoelectric Magnitude Measurements of Uranus Made in 2003**

| Date-UT 2003 | Measured V-Magnitude | V(1,0) | Measured B-Magnitude | B(1,0) | Comparison Star | Observer |
|---|---|---|---|---|---|---|
| June 02.386 | 5.86 | -7.12 | ----- | ------ | Iota Aqr | Schmude |
| June 22.340 | 5.83 | -7.13 | ----- | ------ | Iota Aqr | Schmude |
| June 22.367 | 5.79 | -7.17 | ----- | ------ | Iota Aqr | Schmude |
| Aug. 21.227 | 5.79 | -7.11 | 6.29 | -6.61 | 50 Aqr | Fox |
| Aug. 26.216 | 5.79 | -7.12 | 6.32 | -6.59 | 50 Aqr | Fox |
| Sep. 04.202 | 5.80 | -7.11 | 6.29 | -6.62 | 50 Aqr | Fox |
| Sep. 12.184 | 5.81 | -7.10 | 6.31 | -6.60 | 50 Aqr | Fox |
| Sep. 14.178 | 5.81 | -7.11 | ----- | ------ | Mu Cap | Schmude |
| Sep. 15.164 | 5.81 | -7.10 | 6.32 | -6.60 | 50 Aqr | Fox |
| Sep. 19.161 | 5.81 | -7.11 | 6.31 | -6.61 | 50 Aqr | Fox |
| Sep. 30.178 | 5.79 | -7.14 | ----- | ------ | Mu Cap | Schmude |
| Oct. 01.121 | 5.82 | -7.11 | 6.33 | -6.60 | 50 Aqr | Fox |
| Oct. 01.178 | 5.82 | -7.11 | ----- | ------ | Mu Cap | Schmude |
| Oct. 01.200 | 5.80 | -7.13 | ----- | ------ | Mu Cap | Schmude |
| Oct. 03.137 | 5.77 | -7.16 | ----- | ------ | Mu Cap | Schmude |
| Oct. 03.162 | 5.77 | -7.16 | ----- | ------ | Mu Cap | Schmude |
| Oct. 04.097 | 5.79 | -7.14 | ----- | ------ | Mu Cap | Schmude |
| Oct. 07.123 | 5.83 | -7.10 | 6.37 | -6.57 | 50 Aqr | Fox |
| Oct. 16.181 | ----- | ------ | 6.40 | -6.55 | Mu Cap | Schmude |
| Oct. 17.116 | ----- | ------ | 6.39 | -6.56 | Mu Cap | Schmude |
| Oct. 19.153 | ----- | ------ | 6.39 | -6.56 | Mu Cap | Schmude |
| Oct. 19.180 | ----- | ------ | 6.37 | -6.58 | Mu Cap | Schmude |
| Oct. 25.053 | ----- | ------ | 6.38 | -6.59 | Mu Cap | Schmude |
| Nov. 12.036 | 5.89 | -7.11 | 6.38 | -6.61 | 50 Aqr | Fox |
| Nov. 18.052 | 5.90 | -7.11 | 6.41 | -6.60 | 50 Aqr | Fox |

nus) and $V_{vis}(1,0) = -7.0 \pm 0.02$ (Neptune). The stated uncertainties include only random error.

## Disc Appearance: Uranus and Neptune

Hatton, Maxson and Owens all imaged Uranus. Limb darkening was obvious in most of the images. There were also slight brightness variations in the disc; however, there were no other obvious albedo features on Uranus. The writer searched for shadows cast by the rings of Uranus on the images but he did not find any. Owens imaged both Uranus and the star GSC 5808.88 on Nov. 2 at about 2:33 UT; the star was 6.9 ± 0.3 arc-seconds from the apparent center of Uranus at that time. Uranus occulted this star a few hours earlier but this event was not visible from the United States.

Cudnik, Boisclair, Bannen, I. Tobal, T. Tobal, Venable, Plante, Haas, Gray and this writer observed Uranus, Neptune, or both visually through the telescope. Most observers did not see any albedo features on either planet except for limb darkening. T. Tobal drew some bright spots on the following limb of Uranus on several dates in August 2003. I hope that observers will make a special effort to observe Uranus and Neptune on the 15th of each month when the planet is visible each year. In this way there will be a better chance of obtaining simultaneous observations.

**Table 5: Photoelectric Magnitude Measurements of Neptune Made in 2003**

| Date-UT 2003 | Measured V-Magnitude | V(1,0) | Measured B-Magnitude | B(1,0) | Comparison Star | Observer |
|---|---|---|---|---|---|---|
| June 08.469 | 7.71 | -7.03 | ----- | ------ | Theta Cap | Westfall |
| Aug. 18.360 | 7.70 | -7.01 | ----- | ------ | Theta Cap | Loader |
| Aug. 21.199 | 7.73 | -6.98 | 8.11 | -6.60 | SAO163973 | Fox |
| Aug. 26.190 | 7.73 | -6.98 | 8.06 | -6.66 | SAO163973 | Fox |
| Sep. 04.176 | 7.71 | -7.01 | 8.06 | -6.66 | SAO163973 | Fox |
| Sep. 12.159 | 7.74 | -6.99 | 8.11 | -6.62 | SAO163973 | Fox |
| Sep. 15.141 | 7.73 | -6.99 | 8.07 | -6.65 | SAO163973 | Fox |
| Sep. 19.138 | 7.75 | -6.98 | 8.13 | -6.60 | SAO163973 | Fox |
| Sep. 21.362 | 7.73 | -7.00 | ----- | ------ | Theta Cap | Loader |
| Sep. 21.389 | ----- | ------ | 8.06 | -6.67 | Theta Cap | Loader |
| Sep. 23.416 | ----- | ----- | 8.14 | -6.59 | Theta-Cap | Loader |
| Sep. 23.447 | 7.72 | -7.01 | ----- | ----- | Theta Cap | Loader |
| Sep. 30.125 | 7.78 | -6.97 | 8.10 | -6.65 | SAO163973 | Fox |
| Oct. 01.097 | 7.76 | -6.98 | 8.18 | -6.56 | SAO163973 | Fox |
| Oct. 07.098 | 7.76 | -6.99 | 8.16 | -6.59 | SAO163973 | Fox |
| Oct. 20.057 | 7.79 | -6.98 | ----- | ----- | Rho Cap & Theta Cap | Schmude |
| Nov. 12.013 | 7.81 | -6.98 | 8.14 | -6.65 | SAO163973 | Fox |
| Nov. 18.030 | 7.69 | *-7.10*[a] | 8.12 | -6.68 | SAO163973 | Fox |
| Nov. 20.389 | 7.79 | -7.01 | ----- | ------ | Theta Cap | Loader |
| Nov. 20.402 | ----- | ------ | 8.06 | -6.74 | Theta Cap | Loader |

[a] This value is an outlier and was not used in computing the mean V(1,0) value of Neptune.

The color of Uranus was blue-green with other hues, whereas it was blue-blue-green with other hues for Neptune. Neptune had more blue color than Uranus in 2003.

## Observations of Pluto

Doug West made several photometric measurements of Pluto with a CCD camera equipped with a V-filter. The measurements are summarized in Table 6. Ron Bhanukitsiri used a 0.10-m (4-inch) refractor to observe an asterism of five stars with magnitudes of between 12.5 and 13.6 along with Pluto on June 2 and 4, 2003. Ron carried out careful observations and he summarized his technique in a two-page letter. After reading his letter, the writer has come to the conclusion that Ron actually did observe Pluto.

## Observations of Sedna

Rik Hill submitted an image taken in November 2003 which shows the field where Sedna should have been. The limiting magnitude of the image was about 20.5. Sedna was not visible in this image which is consistent with that object's having a magnitude fainter than 20.5.

## Conclusions

Uranus continued its dimming trend in the V-band in 2003. Neptune maintained about the same V-band magnitude in 2003 that it had in 2000-2002. The discs of Uranus and Neptune were usually reported to be featureless except for limb darkening.

**Table 6: Photoelectric Magnitude Measurements of Pluto Made in 2003***

| Date-UT 2003 | Longitude of the Central Meridian | Solar Phase Angle (degrees) | V-filter Magnitude | V(1,0) |
|---|---|---|---|---|
| Mar. 10.476 | 220° | 1.9 | 14.08 | -0.86 |
| Mar. 12.462 | 332 | 1.9 | 13.81 | -1.13 |
| Mar. 15.471 | 142 | 1.9 | 13.76 | -1.17 |
| Mar. 21.485 | 121 | 1.8 | 13.12 | -1.80 |
| Mar. 26.463 | 041 | 1.8 | 13.90 | -1.02 |

* The comparison stars used for all measurements were TYC 5656 366 and TYC 5657 308

## Acknowledgements

I would like to thank everyone who submitted observation reports of the remote planets during 2003.

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**Table 7: Selected Normalized Magnitudes of Uranus, Neptune and Pluto for 2003**

| Planet | B(1,0) | V(1,0) |
|---|---|---|
| Uranus | -6.59 ± 0.03[a] | -7.12 ± 0.01 |
| Neptune | -6.64 ± 0.02 | -6.69 ± 0.01[b] |
| Pluto | — | -1.20 ± 0.20 |

a A larger uncertainty is assigned due to the discrepancy in the B-filter magnitude of the check star 38 Aqr.
b One measurement of V(1,0) = -7.10 was not included in the mean because it was more than three standard deviations below the next closest value.

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### Jupiter Section

- Coordinator (Section); Richard W. Schmude Jr., 109 Tyus St., Barnesville, GA 30204
- Assistant Coordinator & Scientific Advisor; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706
- Assistant Coordinator, Transit Timings; John McAnally, 2124 Wooded Acres, Waco, TX 76710
- Assistant Coordinator, Newsletter; Craig MacDougal, 821 Settlers Road, Tampa, FL 33613
- Assistant Coordinator, Galilean Satellites; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447
- Acting Assistant Coordinator (Section); Ed Grafton, 15411 Greenleaf Lane, Houston, TX 77062
- Assistant Coordinator (Section); Damian Peach, 466 Vardon Rd., Stevenage, Herts. SG1 5BJ United Kingdom
- Acting Assistant Coordinator (Section); Dr. P. Clay Sherrod, Arkansas Sky Observatory, Conway Offices, 794 Drake Drive, Conway, AR 72034
- Scientific Advisor; Prof. A. Sanchez-Lavega, Dpto. Fisica Aplicada I, E.T.S. Ingenieros, Alda. Urquijo s/n, 48013, Bilbao, Spain

### Saturn Section

Coordinator; Julius L. Benton, Jr., Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410

### Remote Planets Section

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

# ALPO Resources (continued)

## ALPO Staff E-mail Directory

Beish, J.D. .......... dustymars@tnni.net
Benton, J.L. (routine e-mail+observations & images) .......... jlbaina@msn.com
Benton, J.L. (alternate e-mail+observations&images) .......... jbenton55@comcast.net
Brasch, K.R. .......... kbrasch@csusb.edu
Baum, R. .......... richardbaum@julianbaum.co.uk
Cook, A. .......... acc@cs.nott.ac.uk
Cudnik, B. .......... cudnik@sbcglobal.net
Darling, D.O. .......... DOD121252@aol.com
Dembowski, W. .......... dembowski@zone-vx.com
Dobbins, Tom .......... (n / a)
Douglass, E. .......... ejdftd@mindspring.com
Garfinkle, R.A. .......... ragarf@earthlink.net
Garrett, L.S. .......... LSGasteroid@msn.com
Gossett, R. .......... rick2d2@sbcglobal.net
Grafton, E. .......... egrafton@ghg.net
Gray, R. .......... sevenvalleysent@yahoo.com
Haas, W.H. .......... haasw@zianet.com
Hay, K. .......... kimhay@kingston.net
Hill, D. .......... dhill@lpl.arizona.edu
Hill, R. .......... rhill@lpl.arizona.edu
Hines, D. .......... cmpterdevil@hotmail.com
Huddleston, M.W. .......... kc5lei@comcast.net
Jenkins, J. .......... jenkinsjl@yahoo.com
Joyce, D. .......... djoyce@triton.cc.il.us
Kowalski, R. .......... RAK@bitnik.com
Kronk, G. .......... kronk@amsmeteors.org
Lamm, J.S. .......... jlspacerox@aol.com
Larson, S. .......... slarson@lpl.arizona.edu
Limaye, S. .......... sanjayl@ssec.wisc.edu
Lunsford, R.D. .......... lunro.imo.usa@cox.net
MacDougal, C. .......... macdouc@prodigy.net
McAnally, J. .......... CPAJohnM@aol.com
McKim, R.J. .......... rmckim5374@aol.com
Melillo, F. .......... fjmelillo@optonline.net
Minton, R.B. .......... r_b_minton@yahoo.com
Olivarez, J. .......... olivarezhsd@earthlink.net
Parker, D.C. .......... park3232@bellsouth.net
Peach, D. .......... dpeach_78@yahoo.co.uk
Pilcher, F. .......... pilcher@hilltop.ic.edu
Poshedly, K. .......... poshedly@bellsouth.net
Reynolds, M. .......... drmike@astrospace.net
Robertson, T.J. .......... cometman@cometman.net
Sanford, J. .......... starhome@springvillewireless.com
Santacana, G.E. .......... laffitte@prtc.net
Schmude, R.W. .......... schmude@gdn.edu
Sherrod, C. .......... drclay@arksky.org
Slaton, J.D. .......... jd@justfurfun.org
Stryk, T. .......... tedstryk@preferred.com
Timerson, B. .......... btimerson@snows.net
Troiani, D.M. .......... dtroiani@triton.edu
Ulrich, R.K. .......... rulrich@uark.edu
Venable, R.J. .......... rjvmd@knology.net
Wessling, R.J. .......... pinesop@aol.com
Westfall, J.E. .......... johnwestfall@comcast.net
Will, M. .......... will008@attglobal.net

### *Comets Section*

- Acting Coordinator; Ted Stryk, 8211 Tangle Grove Lane, Powell, TN 37849
- Assistant Coordinator; Gary Kronk, 132 Jessica Dr, St. Jacob, IL 62281-1246

### *Meteors Section*

- Coordinator; Robert D. Lunsford, 161 Vance Street, Chula Vista, CA 91910
- Assistant Coordinator; Robin Gray, P.O. Box 547, Winnemuca, NV 89446

### *Meteorites Section*

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

### *Eclipse Section*

Coordinator; Michael D. Reynolds, 2347 Foxhaven Drive West, Jacksonville FL 32224-2011

## ALPO Publications:

### *The Monograph Series*

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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.

# ALPO Resources (continued)

- **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: $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 (Robertson):** *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. To order, send check or money order payable to "Timothy J. Robertson."
- **Lunar (Benton):** (1) *The ALPO Lunar Section's Selected Areas Program (*$17.50). Includes a full set of observing forms for the assigned or chosen lunar area or feature, together with a copy of the *Lunar Selected Areas Program Manual.* (2) *Observing Forms Packet,* $10. Includes observing forms to replace those provided in the observing kit described above. Specify *Lunar Forms*. (See note for Venus.)
- Lunar (Dembowski): *The Lunar Observer*, official newsletter of the ALPO Lunar Section, published monthly. Online at http://www.zone-vx.com/tlo.pdf Also available in hard copy; send SASE ($0.60 each) 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 h.jamieson@bresnan.net.
- **Venus (Benton):** (1) *The 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 Packet,* $10. Includes observing forms to replace those provided in the observing kit described above. 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, Saturn, or lunar SAP sections. Observers should make copies using high-quality paper.
- **Mars (Troiani):** *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").
- **Mars:** *ALPO Mars Observers Handbook,* send check or money order for $10 per book (postage and handling included) to Astronomical League Sales, c/o Marion M. Bachtell, P.O. Box 572, West Burlington, IA 52655; FAX: 1-319-758-7311; e-mail at alsales@astronomicalleague.com.
- **Jupiter:** *(1) Jupiter Observer's Handbook, $10 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 online via the ALPO website or via snail-mail; send SASE to the Jupiter Section Coordinator; (3) *J-Ne*t, the ALPO Jupiter Section e-mail network; send an e-mail message to the Craig MacDougal. (4) *Timing the Eclipses of Jupiter's Galilean Satellites* observing kit and report form; send SASE

# ALPO Resources (continued)

to John Westfall. (5) *Jupiter Observer's Startup Kit*, $3 from the Richard Schmude, Jupiter Section coordinator.

- **Saturn (Benton):** (1) The *ALPO Saturn Observing Kit*, $20; includes introductory description of Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handbook*. (2) *Saturn Observing Forms Packet*, $10; includes observing forms to replace those provided in the observing kit described above. Specify *Saturn Forms.* To order, see note for *Venus Forms*.
- **Meteors:** (1) Pamphlet, *The ALPO Guide to Watching Meteors,* send check or money order for $4 per book (postage and handling included) to Astronomical League Book Service, c/o Paul Castle, 2535 45th St., Rock Island, IL 61201. (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, 161 Vance St., Chula Vista, CA 91910.
- **Minor Planets (Derald D. Nye):** *The Minor Planets Bulletin*, published quarterly $14 per year in the U.S., Mexico and Canada, $19 per year elsewhere (air mail only). Send check or money order payable to "Minor Planets Bulletin" to 10385 East Observatory Dr., Corona de Tucson, AZ 8564I-2309.

## Other ALPO Publications

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- ***An Introductory Bibliography for Solar System Observers.*** **Free** for a stamped, self-addressed envelope. A 4-page list of books and magazines about Solar System bodies and how to observe them. The current edition was updated in October, 1998. Order from: ALPO Membership Secretary.
- *ALPO* ***Membership Directory.*** $5 in North America; $6 elsewhere. Latest updated list of members on 3.5-in. MS-DOS diskette; either DBASE or ASCII format. Make payment to "ALPO" Also available via e-mail as portable document format (pdf) file to requester's e-mail address. Provided at the discretion of the Membership Secretary. Order from Matthew Will, ALPO membership secretary/treasurer.
- **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 44):

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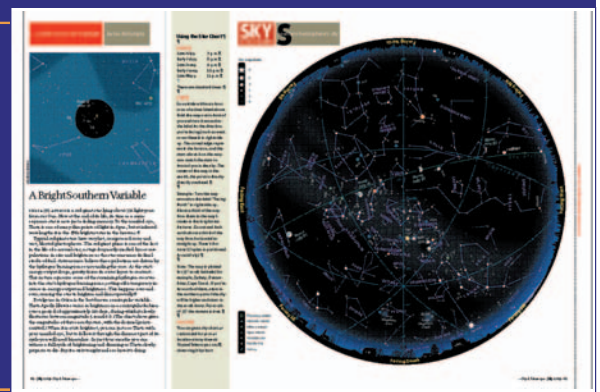


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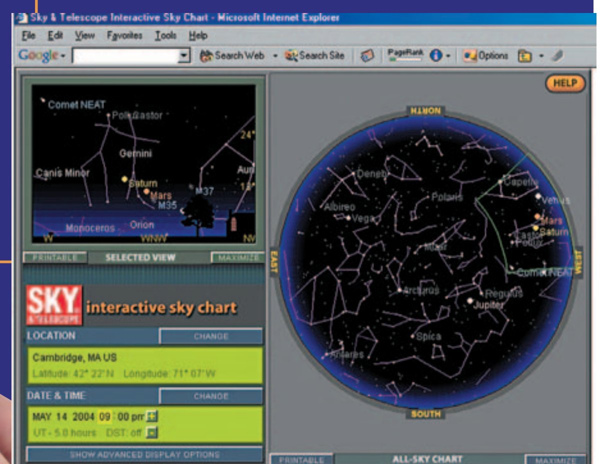


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