

# Journal of the Association of Lunar & Planetary Observers



*The Strolling Astronomer*

Volume 43, Number 2, Spring 2001

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*Inside . . .*

## *The dust storms of Mars*

Now well-placed for observers just about anywhere, the Red Planet plays a game of hide-and-seek with reports of massive dust storms obscuring large portions of the planet.

In this issue, ALPO members Don Parker, Don Troianai and Frank Melillo offer comments and images of their own, with a book review on this topic by Mr. Parker.



**Also** . . . the Sun: a solar rotation report and the value of telescopic observations . . . more on the "spokes" of Venus . . . lunar flashes . . . the ALPO Minor Planets Section . . . an English translation of Flammarion about Mars . . . seeing the Galilean satellites of Jupiter by naked eye . . . a telescopic binoviewer . . . book review by Donald C. Parker, plus the ALPO honors its own at the Astronomical League conference and much, much more.

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

Volume 43, No. 2, Spring 2001

This issue published in July 2001 for distribution in both portable document format (pdf) and also hardcopy format.

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

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

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<http://www.lpl.arizona.edu/alpo>



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## Association of Lunar and Planetary Observers (ALPO)

### Board of Directors

Executive Director (Chair); Julius L. Benton, Jr.  
Associate Director; Donald C. Parker  
Founder/Director Emeritus; Walter H. Haas  
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Member of the Board; Richard W. Schmude, Jr.  
Member of the Board; John E. Westfall  
Member of the Board, Secretary; Elizabeth W. Westfall  
Member of the Board, Treasurer and Membership Secretary; Matthew Will

### Publications

Acting Publisher, Ken Poshedly  
(See full listing in *ALPO Resources* at end of book)

### Primary Observing Coordinators, Other Staff

(See full listing in *ALPO Resources* at end of book)

#### Lunar and Planetary Training Program Coordinators:

Timothy L. Robertson and Matthew Will

**Solar Section:** Coordinator, *Website, SolNet, Rotation Report*, handbook; Richard Hill

**Mercury Section:** Acting Coordinator; Frank Melillo

**Venus Section:** Coordinator; Julius L. Benton, Jr.

**Mercury/Venus Transit Section:** Coordinator; John E. Westfall

**Lunar Section:** Coordinator, *Selected Areas Program*; Julius L. Benton, Jr.

**Mars Section:** Coordinator, *all observations, U.S. correspondence*; Daniel M. Troiani

**Minor Planets Section:** Coordinator; Frederick Pilcher

**Jupiter Section:** Acting Coordinator; Richard Schmude

**Saturn Section:** Coordinator; Julius L. Benton, Jr.

**Remote Planets Section:** Coordinator; Richard W. Schmude, Jr.

**Comets Section:** Coordinator; Don E. Machholz

**Meteors Section:** Coordinator; Robert D. Lunsford

**Meteorites Section (provisional):** Acting Coordinator; Dolores Hill

**Computing Section:** Coordinator; Mike W. McClure

**Youth Section:** Coordinator; Matthew Will

**Historical Section (provisional):** Acting Coordinator; Richard Baum

**Instruments Section:** Acting Coordinator; R.B. Minton

**Eclipse Section (provisional):** Acting Coordinator; Michael D. Reynolds

**Webmaster:** Coordinator; Richard Hill

### Guest Column:

#### Ken Poshedly

#### Acting Editor & Publisher, Journal of the Assn. of Lunar & Planetary Observers

Every issue, we plan to feature in this column the views of an ALPO member about matters of import to our organization and amateur astronomy.



Photo by Russell Whigham

When I first joined this honorable organization in 1962, I was age 12 and totally swept away by the great lunar drawings by Clark Chapman and others in this association's journal. I did my level best to even try my hand at it and sent off a few to Mr. Chapman who returned them with some helpful suggestions. I even planned to become a

professional astronomer, but changed my mind when it became oh-so evident that heavy math was to be my downfall and keep me out of the field as a professional. But I remained impressed by the serious work contained in the JALPO. Never in my wildest dreams did I think I'd be anything more than a silent member.

In 1966, I dropped out of the ALPO and amateur astronomy, but rejoined the ALPO in 1990 when I rediscovered my childhood celestial interest. The journal had gone through some changes; lunar drawings had given way to top-notch astrophotography and the range of instruments expanded to include Schmidt-Cassegrains and the like.

Now, 10 years or so later, I'm working to publish the same journal that impressed me so much as a youngster. While I'm nowhere near as proficient an observer as most of you, I'm contributing in my own way -- using my skills as a professional publications editor to help the ALPO with its journal and similar work.

Walter Haas and John Westfall deserve a standing round of applause for the hard work and tedious hours they spent in compiling and producing this publication. Remember all those term papers you dreaded doing in school. Walter and John did essentially tons of term papers every couple of months for over 50 years!

As for me, I hope that my efforts and methods are not regarded too harshly. I'm sure to err (and already have several times in the first issue), but will hope to make those errors less frequent and less serious as time passes.

I invite and hope that you, the ALPO membership, will work with me by contributing your own work to this journal so that together we can keep the ALPO on track for serious lunar and planetary studies into the far future.

## The ALPO Pages: Member, section and activity news

### Section Coordinators: Deadline for the Next Issue of This Journal is August 1.

#### Errata

The following errors occurred in issue 43.1 (Winter, 2001) of the *Journal of the Association of Lunar & Planetary Observers*:

- Following the review of Robert Reeves' book *Wide Field Astrophotography*, the insert box "About the Author" listed Mr. Reeves name but a biographical sketch of the actual reviewer Klaus Brausch.
- The ALPO Meteorites Section and its acting coordinator, Dolores Hill, were not listed. Ms. Hill has done a most laudable job on the website of supplying informational and instructional material.
- Monographs Nos. 9 and 10 were not listed in the ALPO Resources section.
- The ALPO Resources section listing of recent available back issues of the JALPO has some errors. Vol. 41, Nos. 2 and 4 and Vol. 42, Nos. 1, 2, 3 and 4 are all available.

We regret the errors.

#### Important Announcement

From Julius Benton, Jr., executive director, ALPO: "We regret to announce that, due to personal reasons, Harry Jamieson is resigning from his positions as associate director, membership secretary, treasurer, and acting publisher of the DJALPO effective July 19, 2001.

"Harry has been a loyal and valuable member of the ALPO staff for many years, and we will deeply miss his myriad contributions to the organization and to amateur lunar and planetary astronomy as a whole. His leadership and dedication have been exemplary, and we wish him the very best in the future.

"Effective July 19, 2001, Don Parker will fill Harry's unexpired term as associate director, and Ken Poshedly will assume the role of acting publisher of the association's journal."

The board named Matthew Will as membership secretary and treasurer at its annual meeting on July 26, 2001 in Frederick, MD.

#### Publication Guidelines

The Journal of the Association of Lunar & Planetary Observers (*The Strolling Astronomer*) welcomes reports, articles, and letters for publication. In most cases, such materials are considered for the Journal of the ALPO ; the Guidelines that follow are intended for that Journal. There are also special guidelines for ALPO monographs and proceedings.

The full set of publication guidelines can be found online at <http://www.lpl.arizona.edu/~rhill/alpo/pubguide.html>

#### ALPO Meeting Highlights

The ALPO is proud to announce the winners of its service and observing awards for 2001. Both were announced at the Astronomical League Conference banquet held Saturday, July 28, in Frederick, MD.

Congratulations go to Frank Melillo (Mercury Coordinator) for his receiving the ALPO's highest observing award, the *Walter Haas Award*, and to Harry Jamieson (recently retired Membership Secretary, Treasurer, former Lunar Coordinator and former Executive Director and Board Member) for his receiving the *ALPO Peggy Haas Service Award*.

The board also named Ken Poshedly to its ranks, and Matthew Will as membership secretary and treasurer.

A full report on the conference -- with photos -- will appear in the next journal.

#### Obituary: Robert A. Itzenthaler

From ALPO board member and associate director Donald C. Parker:

"I am very sorry to report that Robert A. ("Big Bob") Itzenthaler died this morning (Wednesday, July 18) from a ruptured aortic aneurysm. Bob was the archivist for the ALPO Mars Section and was one of the team members of the Florida Keys Mars Expedition last month. He was one of the nicest people I have known. We will miss his wit and enthusiasm."

More on Mr. Itzenthaler will appear in the next *Journal*.

## ALPO at ALCON Approaches

While the event is now a part of history, here is the ALCON schedule -- including the ALPO presentations - at this year's event:

### July, 24, 2001, Tuesday

9 a.m. - 12 noon, 1-5 p.m., 6-? p.m. -- AL Executive Council Meeting (voting only by League Council Members or Proxies)

### July, 25, Wednesday

All Day -- National Air and Space Museum tour

9 a.m. - 4 p.m. -- Registration

9 - 9:10 a.m. -- Opening remarks for ALCON

9:20 - 9:50 a.m. -- International Space Station and Amateur Telescope

10 - 10:50 p.m. -- Dr. David Dunham

11 a.m. - 12 noon -- MERAL Meeting

#### LUNCH

1 - 1:50 p.m. -- Jared Lutkowski "Stepping through the Universe: Past, Present, and Future"

2 - 2:25 p.m. -- Joan Carmen, "Archeo-Astronomy Basics"

2:25 - 2:50 p.m. -- To be announced

2:50 - 3:50 p.m. -- "Youth in Astronomy" by Ryan Hannahoe

4 - 4:50 p.m. -- "Beyond the star party: the Big Picture" by Dr. Larry Lebofsky

#### DINNER

7 - 10 p.m. -- International Space Station - Amateur Telescope Committee Meeting

9 - 11 p.m. -- Mars Observing Workshop by Dr. Richard Schmude

9 - ? -- Star Party (To be announced)

### July, 26, Thursday - ALPO Day

8 a.m. - 12 noon and 1 - 4 p.m. -- Registration

8:30 a.m. - 8:40 a.m. -- Welcome and Opening Remarks, Julius Benton

8:40 - 9:10 a.m. -- "The ALPO in the New Century: Looking Back and Looking Ahead", Walter Haas

9:10 - 9:30 a.m. -- YAC Update, Ryan Hannahoe

9:30 - 10:20 a.m. -- "A Solar System Update from the HST", Inge Heyer

10:20 - 10:30 a.m. -- Morning Break

10:30 - 10:50 a.m. -- "Scientific Interests of the Planet Mercury", Frank Melillo

10:50 - 11:10 a.m. -- "ALPO Venus Programs and Recent Observations", Julius Benton

11:10 - 11:40 a.m. -- "Has Lowell's Spoke System on Venus Been Imaged?", Frank Melillo

11:40 a.m. - 12:00 Noon -- "The 'Strange Circumstances' of the 2004 Transit of Venus", John Westfall

12 Noon - 1 p.m. -- Lunch

1:00 - 1:30 p.m. -- "The Pre-History of the ALPO: Amateur Lunar and Planetary Astronomy in the United States Before 1947", Tom Williams

1:30 - 2:00 p.m. -- "Water on Mars: The Views of Viking and Mars Global Surveyor", Eric Douglass

2:00 - 2:20 p.m. -- "Jupiter in 2000-2001", Richard Schmude

2:20 - 2:40 p.m. -- "The Effect of the Eye Position on the Perception of the Bicolored Aspect of Saturn's Rings", Roger Venable

2:40 - 2:50 p.m. -- Afternoon Break

2:50 - 3:10 p.m. -- "The Florida Keys 2001 Mars Expedition: A Quest for Flashers", Don Parker

3:10 - 3:30 p.m. -- "The ALPO Mars Section and the 2001 Apparition of Mars", Dan Troiani

3:30 - 3:50 p.m. -- "Developing Youth in Amateur Astronomy: The ALPO Youth Section Perspective", Matthew Will

3:50 - 4:10 p.m. -- "Photometric and Visual Studies of the Remote Planets in 2000", Richard Schmude

4:10 - 4:30 p.m. -- "The ALPO Eclipse Section", Mike Reynolds

4:30 - 4:50 p.m. -- Open

4:50 - 5:00 p.m. -- Closing Comments, Julius Benton

5:00 - 6:00 p.m. -- Dinner

6:00 - 10:00 p.m. -- ALPO Board Meeting

### July, 27, Friday - IDA Day

8 a.m. - 12 noon -- Registration

All day -- Lighting manufacturing company displays

9 to 9:15 a.m. -- Maryland Delegate Nancy Kopp, "Activities to Control Light Pollution"

9:15 to 10:10 a.m. -- Maryann Arrien, "The Nature of Night", a world-premier, video presentation on light pollution

10:15 to 11 a.m. -- Dr. Tim Hunter, "Skies Downunder"

11:10 to 11:40 a.m. - Bob Gent, "Solving the Problems of Light Pollution"

#### LUNCH

1 to 1:30 p.m. -- Mr. Bill Burton, "Mapping Light Pollution"

1:40 to 2:10 p.m. -- Dr. David Crawford, "IDA Today and Tomorrow"

2:15 to 2:40 p.m. -- Susannah Lazar, NYAA First Place Winner

2:45 to 4 p.m. -- Open time for vendors

4 to 4:50 p.m. -- Dr. Richard Gott, Princeton University, "Time Travel in Einstein's Universe"

#### DINNER

9 - 11 p.m. -- Mars Workshop

9 - ?? - Star Party

### July, 28, Saturday

8 a.m. - 2 p.m. -- Registration

9 - 10 a.m. -- "Youth Programs and Their Impact on Astronomy: A Symposium on Discussing Youth

Involvement in Astronomy, Past, Present and Future"; a roundtable meeting, everyone is encouraged to attend and give their views on how to get youth into astronomy and actives to keep them into it. Note, this will be a panel with audience participation set up. Panelists:

- J. Kelly Beatty, Executive Editor, Sky & Telescope
- Chuck Allen, President, Astronomical League
- Ryan Hannahoe, Chairman, Youth Committee of the Astronomical League
- Bob Gent, Vice Chairman, Youth Committee, Vice President, Astronomical League
- Dr. Larry Lebofsky, Planetary Scientist for the UN of Arizona, President, Arizona Science Teachers Association
- Julius L. Benton Jr., Executive Director of the Association of Lunar and Planetary Observers
- Dr. Richard Gott, Princeton University, YAC Chairmen 1963 - 1965 - tentative

10 - 11a.m. -- AL Business Meeting

11 a.m. - 12 noon -- IOTA Business Meeting

11 - 11:50 a.m. -- NASA, Fred Espenak, aka "Mr. Eclipse" - Eclipses

LUNCH

1 - 2 p.m. -- Spectroscopy for Youth Workshop (Dr. Richard Schmude, Ryan Hannahoe)

1 - 2 p.m. -- Kelly Beatty, Astronomy in Russia: A Status Report- Sky and Telescope

FREE TIME UNTIL BANQUET

5 - 6 p.m. -- Social Hour for Astronomical League's Banquet and Award Presentation

7 - 10 p.m. -- ALCON Awards Banquet

KEYNOTE SPEAKER:

Dr. Tim Hunter

Co-founder and past president of IDA, "Fifty Years of Amateur Astronomy"

**July, 29, Sunday**

Departure from ALCON 2001

For more information, go to:

<http://alcon2001.homestead.com/alcon2001.html>

## Mercury Section News

(We include here a slightly edited version of Issue No. 1 of *Mercury Today*, newsletter of the ALPO Mercury Section, authored by section coordinator Frank J.

Melillo. Details about events between late June when the section newsletter was distributed online by Mr. Melillo and mid-July when this issue of the JALPO was released have been omitted.)

\*\*\*\*\*

## Coordinator's Corner

I am publishing the first newsletter for the Mercury section so everyone will know what's going on and will

hopefully include up-to-date information and all the latest developments that may occur with Mercury. This newsletter will be published every so often. If you have any comments or any matters of interest regarding Mercury, please send them to me via e-mail or regular mail.

## Mercury Now

On August 5th, Mercury will leave the morning sky. Observational reports of Mercury at this apparition are still needed.

## Mercury News

This section cooperates with Dr. Ann Sprague of the Lunar and Planetary Laboratory in Tucson, AZ, where she is one of the leading experts on Mercury. Dr. Sprague has done many research papers, especially on the atmosphere of this planet. Yes, a sodium atmosphere on Mercury! In addition to that, the ALPO Mercury section participates in the "Mercury Watch" program which is managed by Johan Warell of Uppsala University in Sweden. Mr. Warell has made an incredible study of albedo features on Mercury using the 0.5-meter Swedish Vacuum Solar Telescope (SVST) at La Palma Observatory in the Canary Islands. We'll have more about these features in future editions of this newsletter.

## Looking Ahead

Issue No. 2 of *Mercury Today* will cover the preliminary reports about the January/early February and May 2001 evening apparitions. In addition, here are some of the things that may be in future newsletters:

- Dr. Ann Sprague and Johan Warell observations of Mercury
- My own presentation on "Scientific Interests of the Planet Mercury" at the ALCON 2001/ALPO convention in Maryland.
- The Mercury conference in Chicago
- MESSENGER - the future space probes to Mercury
- Some interesting history of Mercury observations
- Making possible observations of Mercury with Dr. Ann Sprague using a 1.5-meter telescope at Mt. Bigelow in Arizona
- A cooperation with the British Astronomical Assn. (BAA) Mercury section and perhaps with the UAI Mercury Recorder in Italy.
- Plus many more. . .

## Mars Section News

(We include here the most recent version of the Mars Section newsletter, authored by Dan Traoiani and Dan Joyce.)

## A Martian Double-Header

In addition to the much-anticipated specular reflections from Edom Promontorium as predicted by Dobbins and Sheehan and observed by several from the optimal southern latitude of the Florida Keys, oriental observers have flashed their observations of a dust storm of unprecedented magnitude for the season in the Hellas/Mare Tyrrhenum region.

Based on observations made in the 1950's plus the repetition of the peculiar alignment positions in the current apparition, Dobbins and Sheehan, upon checking close-ups of Mars Global Surveyor imagery of the appropriate region and orientation, concluded that the mysterious Edom flashing might be detected again. Armed only with modest telescopic equipment, the team led by Tom to south Florida managed to handily image the flashes.

They appear to be the result of frost reflections at crater floors, apparently most conspicuously from one known as Schiaparelli, that orient themselves toward Earth in only very unusual circumstances.

Better yet, Dr. Gaskell and others now believe there may be a repeat of this alignment again soon, as Mars has now swung through its southernmost position and is working its way northward again (see the Mars Section link on the ALPO website for a table of visibility).

As the mechanics of Martian rotation shift the visibility zone, occidentals are hopeful that the dust their Asian colleagues have been imaging will still be available to check out for themselves. The undersigned, with a Wratten #23A filter and a 10-inch, f/8 Newtonian were able to just detect a preceding limb brightening early July 3 UT.

It appears that the storm has at least semi-hemispheric coverage centered about Martian longitude 275 degrees. As many observers as possible are requested to look for this outbreak as the appropriate longitudes become available to them. The dust may have specifically originated either in eastern Hellas or Ausonia Australis, and a dual origin may also be the case.

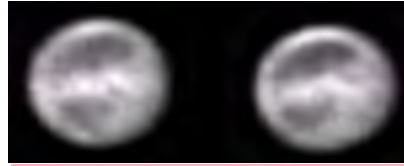
It could become planetary encircling even if not global, so it would be wise to check for possible further spreading. From the imagery already received, there is promise that almost everyone with the proper equipment will witness this event.

## More from Don Parker On the Martian Dust Storm!

“Just a quick note that the dust storm noted in Daedalia on 3-4 July by De Groff, Valimberti, D. Moore, and T. Parker has expanded to Thaumasia. Multiple nodules are noted covering western Aurorae S., Ophir, and the Tithonius complex. Bosphorus and Nectaris P. remain

dark, but dust clouds noted in southern and western Thaumasia, curving around and partially obscuring Solis Lacus and extending northward into Tharsis. The N. hemisphere is largely unaffected.”

## . . . and More on Mars!



Mars on 3 July 2001, Ls - 188°, D - 20.4 arc seconds; photos taken by Frank J. Melillo using Celestron C-8 Schmidt-Cassegrain equipped with Starlight Xpress MX5 ccd camera and Wratten #25 filter. Image left taken 3:50 UT, CM - 59°. Image right taken 4:20 UT, CM - 66°. Additional comments by Mr. Melillo: “With the dust storm alert at beyond both limits, Solis Lacus and Tithonius Lacus are visible with some difficulty. Chryse is very bright in the middle. Very hazy with a possible SPC itself may be seen along the southern limb. In fact, the limb is hazy all around.”

(A report by Frank Melillo includes this ccd image.)

“Here are my latest images of Mars on 7-3-2001. A strong cold front went through the night before so the seeing was 2 on the ALPO scale. I used the adaptive optics and I did my best to bring out as much details as possible.

With Wr. #25, yes, Solis Lacus is visible with a weaker contrast and so is Tithonium Lacus just to the North.

The images look very weird with all haze around the limb. The SPC may be seen but it was difficult to judge. At this CM longitudes at 59 and 66 degrees, it is hard to judge whether the dust clouds can be seen especially along the eastern limb.”

## ALPO Website News

(By Rik Hill)

The big news for 2001 is our Digital Journal of the ALPO (also called *Strolling Astronomer*, and *JALPO*). This is a real boon for the amateur planetary astronomer. Now we can provide color images in every issue as well as getting it to you in a more timely fashion at less expense! The third issue is now available to members giving expanded capabilities that include better layout, larger format, color images in every issue and hyperlinks. For more information on this new for-mat and a sample see our page at:

<http://www.lpl.arizona.edu/~rhill/alpo/djalpo.html>

The ALPO Youth Section has established a chat room for our younger members, thanks to the work of Tim

## *The Strolling Astronomer*

Robertson (Coordinator in the Training Section) and Matt Will (Youth Section Coordinator). Find out more about this at:

<http://www.lpl.arizona.edu/~rhill/alpo/youth/youth-chat.html>

ALPO member, Gary Rosenbaum, has started an e-mail list for digital planetary imaging. An announcement about it can be found at:

<http://www.lpl.arizona.edu/~rhill/alpo/whatsnew.html>

While not an official ALPO function it nevertheless will aid amateur planetary astronomers in improving their skills and capabilities.

On June 21, there was a great total solar eclipse that a number of the ALPO contributors went to see. We invite you to see some of their results at:

<http://www.lpl.arizona.edu/~rhill/alpo/eclstuff/010621.html>

Check the page regularly because there's more to come!

Also, browse the newly expanded eclipse page at:

<http://www.lpl.arizona.edu/~rhill/alpo/eclipse.html>

with excerpts from Observe Eclipses book at:

<http://www.lpl.arizona.edu/~rhill/alpo/eclstuff/observeeclipses.html>

written by Eclipse Section Coordinator, Dr. Michael Reynolds.

The current Mars opposition is dominating the amateur planetary astronomy news lately. In the last few days a new dust storm on the red planet has taken center stage with alerts and information coming from many quarters. A number of amateurs are contributing their observations to the Mars Section and some of these plus the latest alerts on the dust storm are posted at:

<http://www.lpl.arizona.edu/~rhill/alpo/marstuff/marsalert.html>

Our new Mercury Section coordinator, Frank Melillo, has started a newsletter called MERCURY TODAY. This is the first such newsletter for this Section and it will be used to coordinate observations and inform observers of collaborative efforts between professional astronomers or Mercury researchers and this Section. The first edition can be seen at:

<http://www.lpl.arizona.edu/~rhill/alpo/mercstuff/newsletter.html>

There have been some major changes to the Minor Planets Section page at:

<http://www.lpl.arizona.edu/~rhill/alpo/minplan.html>

particularly as concerns the Magnitude Alert Project. Coordinator, Lawrence Garrett has put out a special call for observations of some particular asteroids on a sub-page at:

<http://www.lpl.arizona.edu/~rhill/alpo/minplan/call.html>

Likewise The Lunar Meteoritic Impacts Search program has updated its page at:

<http://www.lpl.arizona.edu/~rhill/alpo/lunarstuff/lunimpacts.html>

Their observers doggedly pursue the little twinkles of light that indicate meteoritic impact on the unilluminated portion of the Moon.

The Solar Section has completely reorganized the way observations by the members are posted. The new page loads faster and has more observations available than ever before, nearly two full rotations worth! Observers are presently using instruments from an ETX-90 on up to a 20 cm solar telescope. To see this page go to:

<http://www.lpl.arizona.edu/~rhill/alpo/solstuff/recobs.html>

Lastly, many new societies and organizations have been added to our Tons-O-Clubs links page. This is perhaps the largest assembly of links to astronomical clubs, societies, associations and organizations on any website. If you notice any are not there or find any broken links at: <http://www.lpl.arizona.edu/~rhill/alpo/clublinks.html>

Then please report them to me as soon as you can and I will fix or add them.

For a handy website that will link you to what's happening in amateur planetary astronomy visit our website regularly as updates are happening daily! As always, if you have some suggestions for the website, or additions feel free to drop me a line at:

[rhill@lpl.arizona.edu](mailto:rhill@lpl.arizona.edu)



## About the Authors

### Richard Myer Baum (Spokes of Venus)



Mr. Baum is a resident Chester, England) and joined the ALPO back in the late 1940s. His particular interests include lunar and planetary observing and his primary field is observational history of Solar System objects, notably the Moon, planets and their satellites. Mr. Baum is a member of the

British Astronomical Association (BAA) since 1947 and is a Fellow of the Royal Astronomical Society since the early 1950s. He has papers in the *Journal of the British Astronomical Association*, *Journal of the History of Astronomy*, *Journal of the Association of Lunar & Planetary Observers*, and publications in Canada, Germany, etc. He also has articles in *Sky & Telescope*, *Astronomy*, *Astronomy Now*, *Urania* and other magazines. He is currently working on *The Haunted Observatory* (Cambridge UP) and papers on the naked eye visibility of the Galilean moons of Jupiter, the discovery of the Mare Orientale (Moon), the selenographical background to H G Wells' *The First Men in the Moon*, and the Lowellian markings of Venus. E-mail Richard Baum at richardbaum@julianbaum.co.uk

### Eric Douglass (Lunar Flashes)



Eric has published articles and/or photographs in *Sky and Telescope*, the *JALPO*, *Astronomy*, and *Selenology*. The

majority of these deal with planetary geology, but have also included materials on videoastronomy and seeing prediction systems. He is a coauthor in the new book *Videoastronomy* (published by *Sky Publishing*), is the editor of the *Digital Consolidated Lunar Atlas* (on line at: <http://www.lpi.usra.edu/research/cla/menu.html>; to be released on CD rom later this year by the Lunar and Planetary Institute), supplied the lunar atlas images to *Observing the Moon* (by Peter Wlasuk), and supplied images and geologic interpretation for the computer program *Lunaview* (by Steve Massey). His primary telescope is a 12.5 inch, f/6 Newtonian. For images, he uses eyepiece projection onto an Astrovid 2000 video camera. The feed from this goes into a digital video processor and is recorded on SVHS. Images

are taken from the tape using a Snappy, and processed on the computer. Eric's primary interests are in planetary geology and photogeologic interpretation. E-mail Eric at [ejftd@mindspring.com](mailto:ejftd@mindspring.com)

The **Geologic Lunar Research Group** (GLR, <http://digilander.iol.it/gibbidomine>) has published articles in *JALPO*, *Selenology*, and Italian magazines. This amateur group is composed of Francesco Badalotti, Giacomo Venturin, Raffaello Lena, and Guido Santacana. It was founded by Raffaello Lena, and has members from several nations that participate in various lunar observing projects. The group communicates primarily through the internet, so allowing tight coordination within projects. The various authors also belong to and hold positions in ALPO and ALS.

### Walter H. Haas (Jupiter Satellites)



Walter is the founder and director emeritus of the Assn. of Lunar & Planetary Observers. Among the

projects he has pursued over a span of 65 years are efforts to detect possible lunar changes caused by lunar eclipses, searches for lunar meteoritic impact-flashes, determination of rotation-periods for features on Jupiter and Saturn, timings of eclipses of the Galilean satellites of Jupiter, estimates of latitudes of the belts on Saturn, and color filter studies of atmospheric phenomena on Mars. He has published many papers in the *Journal of the Association of Lunar and Planetary Observers* and elsewhere. Though he retired in 1983, Walter has remained active with lunar and planetary observations secured with 8-inch and 12.5-inch backyard Newtonian reflectors despite growing trees and brightening city lights, with minor editorial chores, and with service on the ALPO Board of Directors.

### Rik Hill (Solar Activity Report, Synoptic Solar Observations)



Rik's first observation was the transit of Mercury in 1957. He started observing the planets in the early 1960s and has been a member of ALPO since 1975. Rik worked on the Burrell Schmidt telescope (Kitt Peak) for 12 years and is cur-

rently with the Planetary Occultations Group and the Catalina Sky Survey (looking for potential Earth impactors) at the Lunar & Planetary Lab, Arizona State University. In his spare time -- when not doing ALPO business -- Rik can be found at his C11 in the backyard or working with his fossils. He can be reached via e-mail at [rhill@lpl.arizona.edu](mailto:rhill@lpl.arizona.edu).

### **Frank J. Melillo (Spokes of Venus)**

Frank has been interested in astronomy since the age of 11, when Apollo 11 went to the Moon and he was attracted by the beauty of the universe. He used a Tasco 4.5-inch refractor telescope throughout the 1970s. In 1980, he had purchased a Celestron 8-inch Schmidt-Cassegrain which he still has. He started doing astrophotography and joined the Astronomical Society of Long Island, then the AAVSO, the IAPPP and the ALPO in 1985. In 1997, Frank entered the world of CCD imaging and got more interested in planetary imaging. He is more active in ALPO than any other national organizations since the beginning. He is now the coordinator of the ALPO Mercury section. Frank, his wife, Jean, and their 10-year-old daughter, Alyssa, live in Holtsville, New York, 50 miles east of New York City on Long Island.

### **Donald C. Parker (book review; *Telescopic Martian Dust Storms*)**

Donald C. Parker has been a member of the ALPO since 1975, and has held various offices in the organization. He has been a member of the board for a number of years; he has been assistant Mars Section analysis coordinator and Mars Section coordinator. Don himself has been an avid Mars observer since 1954, and observed the global dust storm on that planet of 1956. His film and ccd images have appeared in *Sky & Telescope*, *Astronomy*, *Icarus*, *Science*, *Nature* and many other magazines as well as this journal.

### **This Month's Cover**

Frosty white water ice clouds and swirling orange dust storms above a vivid rusty landscape reveal Mars as a dynamic planet in this sharpest view ever obtained by an Earth-based telescope. The Earth-orbiting Hubble telescope snapped this picture on June 26, when Mars was approximately 43 million miles (68 million km) from Earth -- its closest approach to our planet since 1988. Hubble can see details as small as 10 miles (16 km) across. Especially striking is the large amount of seasonal dust storm activity seen in this image. One large storm system is churning high above the northern polar cap [top of image], and a smaller dust storm cloud can be seen nearby. Another large dust storm is spilling out of the giant Hellas impact basin in the Southern Hemisphere [lower right].

Source: [http://hubble.stsci.edu/news\\_and\\_views/pr.cgi.2001+24](http://hubble.stsci.edu/news_and_views/pr.cgi.2001+24)

### **Frederick Pilcher (Minor Planets)**

Fred joined the faculty in the physics department at Illinois College in 1962, continuing this position through the present. He started observing and writing about asteroids in 1968, and became by invitation a charter member of the ALPO Minor Planets Section when founded in 1973 by Richard Hodgson. When Hodgson left this position in 1980 he assumed the post of Section Recorder (later Coordinator), also continuing through the present.

### **Ted Stryk (Flammarion)**



"At the time I wrote this article, I was a Philosophy major at Carson-Newman College in Jefferson City, TN, and am now a graduate student at the University of Tennessee in Knoxville. Originally from Bristol, Virginia, I joined the ALPO in 1992 largely out of an interest in Mars. I have frequently contributed visual (and occasionally photographic)

observations, and have written a few Mars-related papers in this journal. This project combined my interests in history, Mars, philosophy, and to some extent psychology, as well as some study of French. Much thanks to Richard McKim for getting me access to the Royal Astronomical Library.

### **Richard J. Wessling (Binoviewer)**



Mr. Wessling is the acting assistant coordinator of the ALPO Instruments Section. As such, his purpose is to motivate and assist our membership to improve the performance of their telescopes as well as their observing practices. Rich writes articles about different aspects of

instrumentation used for observing, including design and construction of telescopes. E-mail contact is encouraged for quick assistance. He has been a member of the ALPO since 1968, acting as director of the lunar and planetary training program in the early 1970's. He has been making telescope optics since 1965, specializing in reflective Newtonian mirrors as well as tilted component telescope optics, and has published several articles about the various instruments he has built. Rich has an optical business where he offers free testing of Newtonian primary and diagonal mirrors. He also offers a refiguring service for the primary mirrors. Richard works as Distinguished Optician at Corning Precision Lens, Inc. located in Cincinnati, Ohio, where he is responsible for developing, testing, and improving prototype lens designs and manufacturing processes.

## ALPO Feature: ALPO Solar Section, Solar Activity Report Carrington Rotations 1901-1910 (1995-09-29.81 to 1996-06-28.70)

By Richard E. Hill, Coordinator  
ALPO Solar Section

Solar activity was low to extremely low for the period. There were only 47 numbered active regions on the Sun during this time with a mean R(I) of 9.7 and a mean R(A) of 9.5, as shown in Figure 1, less than half of the last report period. All rotations had a number of days with a count of 0 which meant that the variations in the averages were almost totally driven by the highs. Neither R(I) nor R(A) showed any tendency to be systematically higher than the other number. The highest daily number for R(I) was 58 and for R(A) was 57 which occurred in the rotation with the highest activity for the period, CR-1901 (Carrington Rotation) with average R(I) of 23.0 and R(A) of 22.5 illustrating how the highs alone drove the averages in this reporting period. Below is a graph of the rotational means for this reporting period. In general, it shows that activity is at solar minimum.

As one might expect, there were few observers and observations covering this period. This is typical for solar minimum, but it should be stressed that observations are just as important when activity is low as when it is high.

Early evolution of active regions can be studied in detail at this time as few groups ever evolve past B or C class.

Most terms and abbreviations used in this report are defined in the Astronomical League book *Observe and Understand the Sun*. See their website at <http://www.astroleague.org> or contact them in writing for details at Astronomical League Sales, P.O.Box 572, West Burlington, Iowa 52655. References to sunspot classifications (the "McIntosh Classification System") are explained in the new Astronomical League publication, in *A Three-Dimensional Sunspot Classification System* (JALPO, 33, Nos. 1-3, Jan., 1989, pp. 10-13) and on our webpage at: <http://www.lpl.arizona.edu/~rhill/solar.html>

All times used in this report are Universal Time (U.T.) and directions are abbreviated (e.g. , N, E, SW etc.) on the sky. Angular

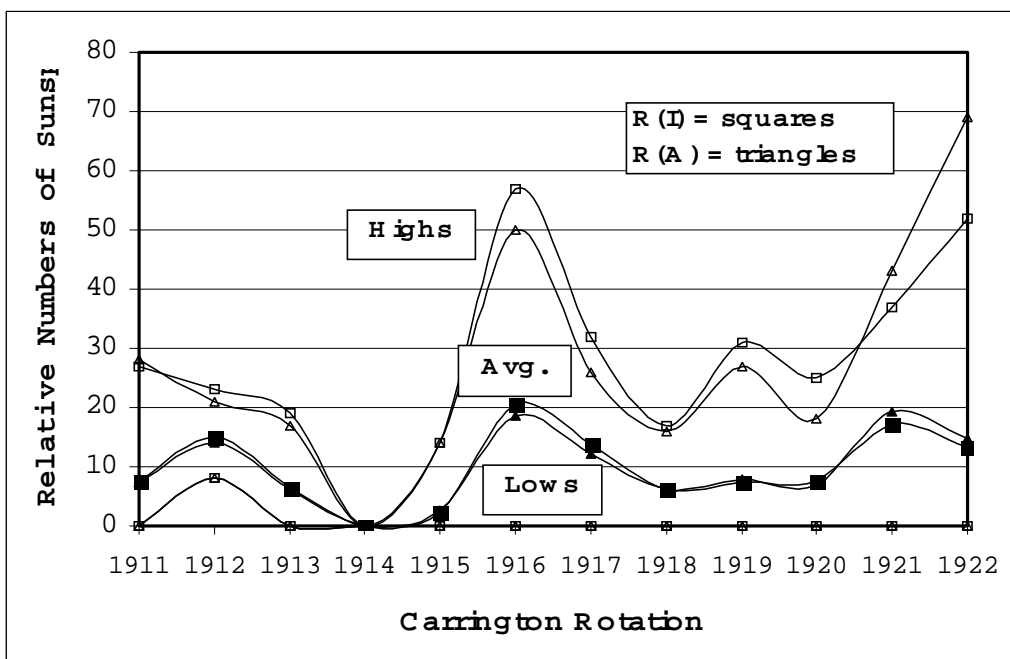


Figure 1: R(I) and R(A) for rotations 1901-1910 (1995-09-29.81 to 1996-06-28.70)

dimensions however, are heliographic. The term "group" refers to white-light collections of sunspots, while region refers to whole areas of activity in all wavelengths. All areas will be expressed in the standard millionths of the visible solar disk (500 millionths is about the minimum area needed for a sharp-eyed observer to see a naked eye sunspot). Active Regions are indicated with the prefix AR and are designated by the Space Environment Center (SEC) of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado.

**Table 1: Observers for this reporting period in alphabetical order**

Name	Telescope				
	Aperature (cm)	Focal Length (cm)	Stop	Type (cm)	Location
Brian Cudnik	11.3	90	refl	n/a	Houston, TX USA
Gordon Garcia	13	102	refr	n/a	Hoffman Estates, IL USA
Richard Hill	12.5	125	s-c	n/a	Tuscon, AZ USA
Paul Maxson	25	152	refl	15	Phoenix, AZ USA
Jeffery Sandel	6	70	refr	n/a	Cayce, SC USA
Fan-Lin Tao	25	375	refr	n/a	Tapei, R.O.C.
Brad Timerson	11.4	127	refl	n/a	Newark, NY USA

**Table 2: Solar Cycle 22, Rotation 1901**

Dates: From 1995 09 29.81 to 1995 10 27.10			
	Mean	Max. & Date	Min. & Date
R(I)	23	58, 10/13	0, 6 days
R(A)	22.5	57, 10/12	0, 6 days

This was the most active rotation of this whole report and indeed the most active since CR-1894. Just three observers contributed 11 observations and spot maps (Fan-Lin Tao) of the 11 active regions designated by S.E.C.

The best region of the rotation was AR 7912 (lat.=S10). Its greatest extent and size was achieved on 10/13 and was almost solely responsible for the maximum of this rotation. The best observation of this region was one of the first digital images from Gordon Garcia, a white light image taken on 10/15 at 1522UT, one day past central meridian (Figure 2). It gives us a snapshot of the sunspot group as a round leader, with a symmetrical penumbra surrounding, followed by about a dozen or so smaller spots. Its class at this time was generously estimated to be Eso. It remained essentially the same when observed again by Tao on 10/18.

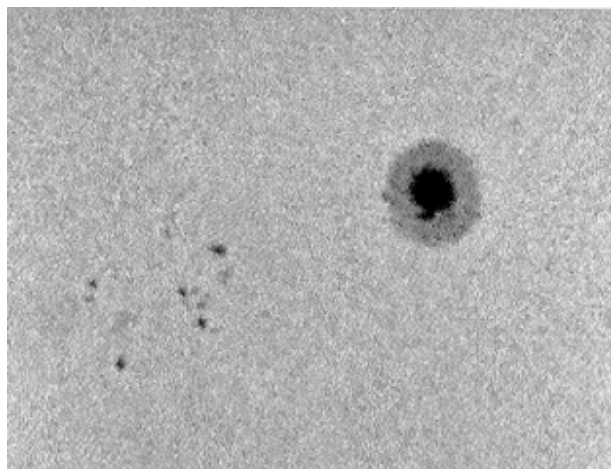


Figure 2: 10/15/95, 15:22 UT, rotation 1901. 130 mm refractor on ST5 CCD by Gordon Garcia.

**Table 3: Solar Cycle 22, Rotation 1902**

Dates: From 1995 10 27.10 to 1995 10 123.40			
	Mean	Max. & Date	Min. & Date
R(I)	10	33 11/17	0 6 days
R(A)	11	33 11/ 17	0 5 days

In this rotation activity dropped to less than half that of the previous rotation with only eight regions designated by S.E.C. Reported observations dropped as well with only six photographs from Maxson and spot maps from Tao being the only submissions. The largest active region of the rotation was AR 7921 (lat.=S10). This region was first observed in a Maxson photo on 11/10 at 1717UT as a single round spot with symmetrical penumbra. It was again imaged by him on 11/12 (1858UT) and 11/16 (1745UT) and displayed no changes from the former Hsx class. This indicates that this group, if a single spot can be called "group", is the last remains of a larger group, probably AR 7912 from the previous rotation. Such a configuration (Hsx) can persist for over

a rotation as it reduces in size and then loses penumbra.

**Table 4: Solar Cycle 22, Rotation 1903**

Dates: From 1995 11 23.40 to 1995 12 20.72			
	Mean	Max. & Date	Min. & Date
R(I)	8.7	19, 12/9	0, 8 days
R(A)	9.0	20, 12/9	0, 7 days

Activity levels in this rotation fell nearly 20% or so to very low levels with only four groups designated during the rotation. Received data fell as well, and by about the same amount. Maxson was the only contributor.

The only region of interest was AR 7930 (lat.=S11) that barely attained an area of 120 millionths. Of the nine Maxson photographs only two showed this region. In both it was a small round spot with symmetrical penumbra. This was probably the decaying remains of AR 7921 of the previous rotation (and therefore AR 7912 from two rotations ago) underscoring the note in the last rotation on the persistence of these decaying Hsx regions.

**Table 5: Solar Cycle 22, Rotation 1904**

Dates: From 1995 12 20.72 to 1996 01 17.06			
	Mean	Max. & Date	Min. & Date
R(I)	13.7	48, 1/5	0, 9 days
R(A)	11.9	38, 1/6	0, 6 days

Seven regions were designated in this rotation and while levels of activity increased slightly the number of days without any spots

increased as well. This meant that when there was activity it was greater than in the active regions of the last two rotations. The numbers of observations more than doubled (15 + Tao spot maps) but that still did not cover each day of the rotation.

The best covered and most active group of the rotation was AR 7938 (lat.=N12). It formed on the disk on 01/02 but was first observed in a drawing by Hill on 01/04 at 2236 UT. At that time it was classed as Dai with a leader spot that consisted of eight umbrae in an "L" shaped penumbra followed by a middle collection of half a dozen tiny umbrae in rudimentary penumbra. The follower spot was another half dozen tiny umbrae elongated in an E-W teardrop shape pointing back towards the leader and surrounded by penumbra. To the N of the follower was a collection of 4-5 umbrae in rudimentary penumbra. No observations were available for 01/05 but on 01/06 in a Maxson photograph (1807 UT) and a Hill drawing (1857 UT) the leader was shown to have broken into three pieces in a N-S line, each with 3-4 umbrae in rudimentary penumbrae. The middle spots, or collection of spots, was gone. The follower was 4-6 umbrae in rudimentary penumbra with a scattering of umbrae and pores surrounding. The whole region was seen in, and surrounded by faculae. The next day, the last day for which we have

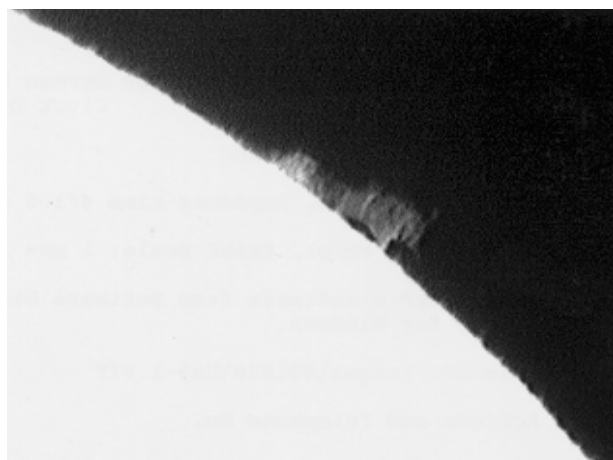


Figure 3: 12/28/95, 17:27 UT, rotation 1904. 130 mm refractor on ST5 CCD by Gordon Garcia.

observations, Maxson (photo at 1850 UT), Hill (drawing at 2150 UT) and Cudnik (drawing at 2252 UT) showed the group, now class Cao, near the limb. The leader was now two groups of umbrae each in their own rudimentary penumbra with a follower that was 8-10 umbral spots and pores. The group was decaying and both the leader and follower were surrounded by separate facular regions.

**Table 6: Solar Cycle 22, Rotation 1905**

Dates: From 1996 01 17.06 to 1996 02 13.40			
	Mean	Max. & Date	Min. & Date
R(I)	4.3	16, 1/30	0, 15 days
R(A)	4.4	17, 1/30	0, 15 days

This was the lowest activity of the reporting period with levels falling to half that of any previous rotation since 1987. This was extremely low activity with no spots being reported for over half the days. Only five observations were reported, four photos by Maxson and one Cudnik drawing, in which no spots or other activity was observed. Only two regions were designated by S.E.C. but several more were reported by other observatories. These tend to come into existence as A-class groups, survive on the disk for a few minutes to a couple hours and then vanish. An enterprising observer seeing one of these pop into view would do well to try and document the whole life of these groups.

**Table 7: Solar Cycle 22, Rotation 1906**

Dates: From 1996 02 13.40 to 1996 03 11.73			
	Mean	Max. & Date	Min. & Date
R(l)	5.4	17, 2/24	0, 13 days
R(A)	6.4	21, 2/24	0, 11 days

Things picked up slightly in this rotation but activity still remained very low. The largest of the seven groups designated in this rotation did not get any bigger than 100 millionths. The very small amount of data submitted included: three Garcia photos (2 H-alpha disk and one H-alpha prominence photos) all taken the same day and one Garcia whole disk drawing showed no activity at all.

**Table 8: Solar Cycle 22, Rotation 1907**

Dates: From 1996 03 11.73 to 1996 04 08.03			
	Mean	Max. & Date	Min. & Date
R(l)	9.8	23, 3/26	0, 7 days
R(A)	9.7	22, 3/26	0, 5 days

Though levels of activity were very low still it was an increase over the previous rotation. Observers submitted eight photos and four drawings which did manage to give some coverage to the largest of the three regions, AR 7953.

This region was first seen at lat.=N07 by Garcia in an H-alpha photo at 1554 UT and in a Maxson (white light photo) at 1745 UT on 3/22. The H-alpha showed the region to be unremarkable. In white light the leader was seen to be a teardrop shaped spot with penumbra followed by a middle grouping of two clusters

arranged N-S. Each was about four umbrae in rudimentary penumbrae. These were followed by 2-4 umbrae again in rudimentary penumbrae. This was maximum development for this group as the next day another Maxson white light image showed the group undergoing decay. One of the middle clusters was gone and the follower was just a few umbral spots. The leader was now more round with a symmetrical penumbra. The last observation of this group was on 3/24 and showed the leader unchanged with the middle collection just being a N-S string of half a dozen umbrae. The follower spot was now gone.

**Table 9: Solar Cycle 22, Rotation 1908**

Dates: From 1996 04 08.03 to 1996 05 05.28			
	Mean	Max. & Date	Min. & Date
R(l)	4.3	19, 4/18	0, 17 days
R(A)	4.6	17, 4/18&19	0, 15 days

Activity returned to extremely low levels in CR-1908 with only five regions being designated. However, observations did not decrease. Garcia submitted 2 H-alpha images, Maxson seven white light photos. These did give us a two day peek at AR 7958, the largest region of the rotation that attained a maximum area of 100 millionths.

On 4/20 Maxson photographed this region at 1613 UT. The leader was a few umbral spots and the follower, the larger of the two spots, was a few larger umbral spots in rudimentary penumbra at a heliographic latitude of S07. A day later both Maxson (1559 UT) and Garcia (1646 UT) photographed the spot group. The leader was now the larger spot with six umbrae in penumbra with the follower being unchanged from the previous day.

**Table 10: Solar Cycle 22, Rotation 1909**

Dates: From 1996 05 05.28 to 1996 06 01.50			
	Mean	Max. & Date	Min . & Date
R(l)	6.3	18, 5/11	0, 13 days
R(A)	7.3	29, 5/11	0, 12 days

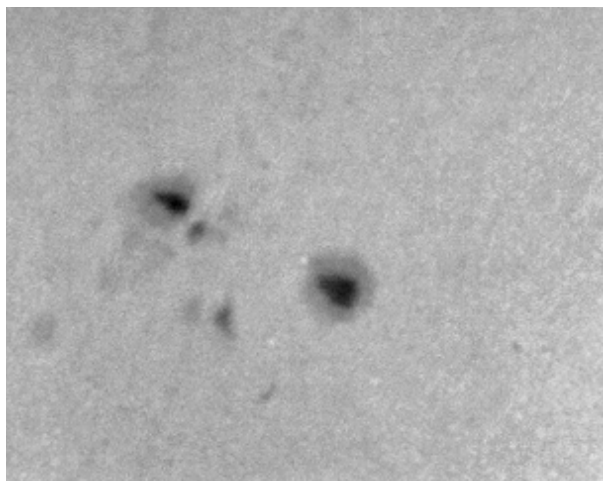


Figure 4: 5/11/96, 15:58 UT, rotation 1909. 130 mm refractor on ST5 CCD by Gordon Garcia.

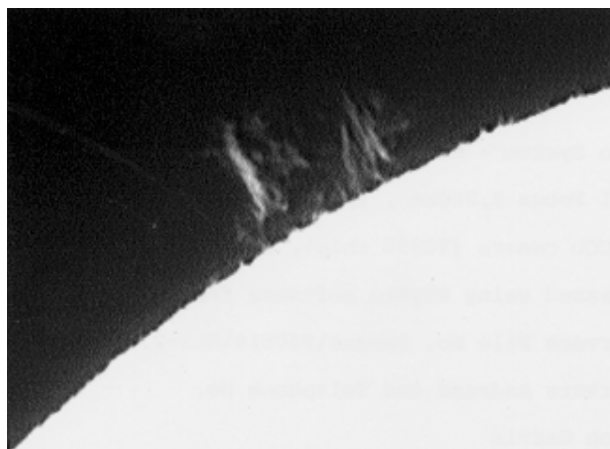


Figure 5: 5/18/96, 16:06 UT, rotation 1909. 130 mm refractor on ST5 CCD by Gordon Garcia.

While activity increased to very low levels with only seven regions designated, observations remained the same. Nine photographs were submitted: two by Garcia and seven by

Maxson. These did manage to give us a brief look at AR 7962.

On 5/11 this region was photographed by both observers Garcia at 1558 UT (Figure 4) and Maxson at 1733 UT (Figure 5) at a latitude of S06 and nearly on the central meridian.

The leader spot was teardrop shaped with asymmetrical penumbra followed by another such spot that was slightly smaller with penumbra only on the following side. The two teardrop spots were pointing at each other. This makes one wonder if they were the result of the breakup of a larger spot. More observations would have revealed this. The follower spot was surrounded by small umbrae. A day later Maxson (1557 UT) showed the leader relatively unchanged but the follower was being disrupted with the penumbra breaking down. The last observation of this spot group was six days later when it had just passed around the limb. Garcia (1606 UT) in an H-alpha prominence photo showed a hedgerow prominence at the latitude of this region.

**Table 11: Solar Cycle 22, Rotation 1910**

Dates: From 1996 01 01.50 to 1996 06 28.70			
	Mean	Max. & Date	Min. & Date
R(l)	11.5	25, 6/9	0 5 days
R(A)	11.4	2, 4 days	0 5 days

This reports closes with activity on the rise to low levels while data more than tripled. Eight regions were designated by the S.E.C. with AR 7973 being the largest attaining an area of about 100 millionths on 6/21.

On 6/19 Maxson (1523 UT) in a white light photo, showed AR 7973 to consist of a single round spot with symmetrical penumbra, class



Hsx. It remained this way until it left the disk on 7/01 with the only changes being in the surrounding faculae, noted by Sandel.

## Conclusions

With this report solar Cycle 22 ends and solar Cycle 23 begins. The date of sunspot minimum was May 1996, meaning CR-1910 was the first rotation of Cycle 23. There were some notable features of Cycle 22. It had the shortest rise from minimum to maximum of any recorded cycle and was 4th in amplitude of cycles since the first one that started in February 1755 (IPS). This cycle's max ended with a sudden drop in the sunspot number early in 1992. The minimum occurred early as well giving this cycle a length of only 9.7 years rather than the historical mean of 11.1 years. But this is not as unusual as it might seem since six of the last seven cycles have been shorter than average (Cycle 20 being the only exception at 11.6 years). However, Cycle 22 was the shortest of these six. The reason for this is not understood nor is the probability for continued short cycles. The understanding of these phenomena will rest on the accurate observations by people like those in this Section.

While this report seems a bit skimpy, this is what it's like at solar minimum. It is the second minimum observed by the Solar Section. We use these times to catch up on our reports. As this is being written we are at solar maximum and I can assure the reader, reports will be much more meaty very soon. Presently, in one rotation, we are taking in more than ten times the total number of observations contained in this report!

It is important to point out that even when there seems to be no activity, especially if just in terms of visible spot groups, still there are good reasons for observing the Sun and especially imaging the Sun. There are a number of manifestations that are displayed as precursors to significant activity that might be missed if

only the "best" days are observed. Discreet brightening, clusters of pores, or even changes in the mottled appearance of the granulation can presage the outbreak of a new active region. Polar faculae and sudden appearance and disappearance of high latitude spots can signal the start of a new solar cycle. But these will only be seen by the diligent and persistent observer.

## References

For computation of R(I) numbers, positions, classifications and designations used in this report:

- 1) Solar-Geophysical Data (Prompt Reports), Part I, No.615, November 1995.
- 2) Solar-Geophysical Data (Prompt Reports), Part I, No.616, December 1995.
- 3) Solar-Geophysical Data (Prompt Reports), Part I, No.617, January 1996.
- 4) Solar-Geophysical Data (Prompt Reports), Part I, No.618, February 1996.
- 5) Solar-Geophysical Data (Prompt Reports), Part I, No.619, March 1996.
- 6) Solar-Geophysical Data (Prompt Reports), Part I, No.620 April 1996.
- 7) Solar-Geophysical Data (Prompt Reports), Part I, No.621, May 1996.
- 8) Solar-Geophysical Data (Prompt Reports), Part I, No.622, June 1996.
- 9) Solar-Geophysical Data (Prompt Reports), Part I, No.623, July 1996.
- 10) Solar-Geophysical Data (Prompt Reports), Part I, No.624, August 1996.
- 11) ISP - Radio & Space Services (website)

For computation of R(A) numbers, final daily numbers from the SGDC website were used.

## **ALPO Feature: The Value of Synoptic Solar Observations With Small Telescopes**

**By Richard Hill, Coordinator  
ALPO Solar Section**

### **Abstract**

A method for analyzing solar images over long time scales is presented along with the results in video format.

A frequent question from prospective A.L.P.O. Solar Section observers is this: "Is my telescope big enough to do anything useful?" This requires some translation. The word "big" is often replaced with "good" but means the same thing. The phrase "anything useful" is what will be addressed here. However, as of this date, no one has ever been turned away from ALPOSS for equipmental inadequacy. Assistant Coordinator Gordon Garcia has been tireless in bringing all new observers up to a standard in the Section such that all data now being submitted, and it is in record amounts for us, is both usable and useful.

The smallest telescopes being used in the Solar Section are the 60 mm refractors seen in many department stores and telescope shops. They are limited in their abilities but for solar observing they do a pretty good job. Most observers use these to make drawings of solar activity. We have three observers making drawings in the Section on a regular basis and their work gives us an almost unbroken record of solar activity over the last couple years. The word "almost" is used because there are occasional one or two day gaps.

Most observers do some form of imaging from tried-and-true photography, to CCD and video. This kind of observing is more demanding of time so the record here has more gaps. But we often have whole rotations were not a day of imaging is missing. Few Sections can claim 28 or more days without gaps in the record!

Combining these two modes of observing, drawing and imaging, we essentially have an unbroken record for the last two years. This has been one of our goals since 1982 and is now met. Such coverage is essential if we are to understand the motions between and within sunspot groups. When activity summary reports are being made it is not uncommon for me to have a tableful of photographs and computer printed images, covering many

days, laid out so that some idea of what was happening can be gleaned. While some broad notion of motions and changes can eventually be understood, still things are being missed.

In the past, the way to thoroughly understand activity in a sunspot group was to observe it photographically with one telescope over a long period of time, spend days in a darkroom making prints to scale with matching orientations, and then individually copying each print onto 16 or 35 mm film that could be then shown as a movie. This was not routinely done because of the hours of labor involved. It was more common to see movies shot one frame at a time in the telescope over the span of one or two hours that would show some motions with short lifetimes but large scale. This long term motion was very rarely observed.

With the advent of multi-megabyte RAM, multi-megahertz processor speeds, and multi-gigabyte hard drives, it has become possible to not only dramatically reduce the time needed to produce a movie similar to those of the past, but to do it over a longer time interval using synoptic observations from a variety of instruments. Morphing software has allowed images to be merged in a smooth sequence never possible with photography. Even limb foreshortening can be handled in just a few minutes with software available for free in many cases.

While coverage of the latest solar cycle, Cycle 23, has been excellent by the Solar Section, still one could wish for more, perhaps greedily. Observers are now spread in a small band of longitudes from Joao Porto (ETX telescope) in the Azores at approximately 27° west longitude to observers in California-Oregon at 123°-124°, just under 100° of longitude or a little over a quarter of the globe. Thus our coverage of the Sun is limited to 09h-17h UT in imaging and 12h-22h in drawings or about 09h-22h UT total-roughly half a day. (Our contributors from Romania, Hungary and the Philippines all died in the early 1990s.) The new morphing software lets us cover over the unobserved time periods in a smooth fashion more pleasing to the eye and allowing one to make better sense of motion than an image that jumps about.

The technique is not difficult and can largely be accomplished for one active region in an evening. First a set of images must be selected for a given region. This will

often have to be done from a database of images taken with everything from an ETX (90 mm f/13) to the popular 8" Schmidt-Cass. The highest resolution image is not always the best choice. Usually the weeding out process will take place for the dataset during the processing as problems with individual images are discovered. The images near the limbs must next be corrected for foreshortening. When this is done the last cut of the dataset is finished and the images that will be processed to completion are selected. One is selected as being the best scale. All others are matched to it and all images are made to the same pixel dimensions and rotation.

Detailed instructions on these processes cannot be given here as they will vary in different software packages. It is helpful at this point to have software that can show all the images as thumbnails in one window. Using this, all images must be now matched for contrast/brightness and position in the frame. If in this process blank spots appear in the image, it is a good idea to cut and paste in portions of contrast/brightness matched photosphere into these spots to cause the morphing software to work more smoothly.

The last step in this process is to match resolution. My favorite way to do this is with pixel averaging. This is the weak point in this process. All images must be reduced to the resolution of the poorest. But it is a small price to pay for the information gained from the final result.

Using these images a morphing program is loaded. In the video shown with this presentation the seven of the eight images of Active Region 8323 shown were converted into 50 images each and morphed over 17 sec. ending with the eighth image. What was revealed is startling. The leader spot is in the upper right, the follower in the lower left. In the middle is a spot about twice the size of the earth that determined the dynamics of this sunspot group over the week shown.

The middle spot, over the whole period, plowed its way through the leader spot merging with the umbrae in the leader and imparting rotation to it. Most people are fooled by the solid appearance of the Sun's surface. It is a gas under extreme heat and pressure, a plasma, and thus acts more like a fluid than a solid or a gas. Because of this, in the final 5 sec. of this series, the spots and penumbral bits in the middle of this group, left in the wake of this rapidly moving spot, can be seen to swirl like flotsam on water in the wake of a boat. It is possible that the motion of the large middle spot would have been noticed using the previous methods of analysis, but not likely. However the rotation imparted to the middle portion would have been totally missed. Even knowing

this in advance it is difficult to see in the eight still images.

During this whole time the spots in the follower were pushed back, consolidated and then began dissolution. In that this group was followed from the time it came on to the disk, it is not possible to know what took place earlier than 30 Aug. It would be nice to know the origin of the middle spot. From motions shown in this movie, it seems likely that it was originally part of the follower portion of this group. How nice it would be to have had images from a few days earlier!

It is a pleasure to be able to present these data done by observers of the ALPO Solar Section. The data used in the preparation of this paper was submitted by: Joao Porto, Art Whipple, Jamey Jenkins, Gordon Garcia, G.M.Stewart and Mike Boschat. Without their efforts this would not have been possible.

Have you ever wondered what to do with that telescope during the day? Why not try solar astronomy? The newly revised *Observe and Understand the Sun* manual can help you learn how to enhance and expand upon what you already know. This is a compendium of knowledge and techniques for the solar observer. It is a collection of essays on different aspects of solar observing, from solar telescope design to solar photography. It also covers the more esoteric subjects of monochromatic observing and spectroheliscopes. Each section is written by a different author and edited by Richard E. Hill, who also wrote the section on sunspot classification. This book includes an excellent bibliography on solar topics and also several useful website address. *Observe and Understand the Sun*, edited by Richard E. Hill, 63 pages, published 1990, revised 2000 by the Astronomical League. Price: \$12

## ALPO Feature: Venus Has Lowell's Spoke System on Venus Been Imaged?

By Frank J Melillo and Richard Baum

### Abstract

CCD/UV images at 360nm taken by Frank J Melillo in April 1999 to monitor activity in the upper atmosphere of Venus show a pattern of markings similar to the spoke system first reported by Percival Lowell in 1896.

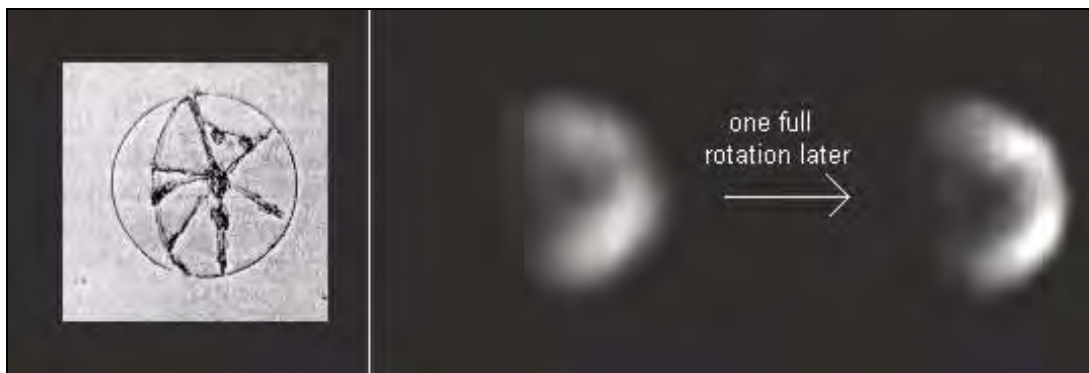
### Introduction

Venus, "The Goddess of Love", is the third brightest object in the heavens. It is bright enough to be seen during the day and to even cast a shadow at night. During ancient times, many observers were unaware that its morning and evening apparitions signified a single object. For example, the Romans knew it as Vesper when it was an evening object, and as Lucifer in the morning. The Greek alternatives were Hesperus and Phosphorus, respectively. Once the truth was recognized however, the Cytherea of the Greeks became the Venus of the Roman world, the name by which it is known today.

In respect of diameter, mass and gravity, the older astronomers often referred to Venus as earth's twin. Now we know better. Venus is a harsh, hos-

tile planet, swathed in a dense veil of corrosive gases with a surface so hot that it glows from its own heat. It rotates backward while the polar axis tilts at 177 degrees, and takes about 243 earth days to rotate on its axis.

Venus, as seen from earth, is almost featureless in integrated light. All we ever see is a shifting panorama of cloud scenery. Galileo pointed his telescope at the planet in 1610 and discovered the phases. Cassini and Bianchini in the seventeenth and eighteenth centuries made out hazy cloud-like markings but did not agree as to their form or stability. Even the enigmatic satellite, so often sighted in the seventeenth and eighteenth centuries was eventually declared apocryphal. And so at the end of the nineteenth century, after almost three centuries of close observation, astronomers were agreed only that the planet was surrounded by a dense and extensive atmosphere. Venus had effectively refused the telescope. Not until the advent of new technologies and the introduction of advanced observational strategies in the twentieth century was the uncertain vision of the telescope transformed.



Radial pattern on Venus as sketched by Percival Lowell on 28 October 1896, and as photographed by Frank J. Melillo on 25 April 1999 (left) and 30 April 1999 (right, after one full rotation of Venus). Both images taken with Celestron C8 (8-inch Schmidt-Cassegrain) telescope equipped with Starlight Xpress mx-5 ccd camera and UG-1 UV filter and infrared blocker. Both images 2 seconds, at f/25. Image at left: disk illumination = 72 percent, disk size = 15.2 arc seconds, seeing = 9. Image at right: disk illumination = 70 percent, disk size = 16.0 arc seconds, seeing 9 - 10 (10 = best).

## **Observations of the Spoke System**

G. D. Cassini (1666-1667), F. Bianchini (1726-1727), J. H. Schroeter (1779-1800) and William Herschel (1793) were among the earliest observers to detect anything of interest on the shining disk of this planet. The chief preoccupation was to locate markings of sufficient contrast and permanency from which to determine the planet's rate of diurnal spin or rotation period. Initially observers were influenced more by terrestrial analogy than anything else, and until 1890 with one or two exceptions, values ranged between 23 and 24 hours. But in the latter year the great Italian observer G. V. Schiaparelli announced a shock result. Venus, from his observations, was apparently locked in synchronous rotation, one hemisphere was constantly baked by the sun, the other wrapped in eternal night.

Working from this premise the wealthy amateur Percival Lowell who in 1894 set up a planetary research center at Flagstaff, Arizona, began his study of Venus in August 1896. At first he saw little more than anyone else, just a few hazy bandlike markings, and streaks. It was usually faint and elusive. As the days turned into weeks however, something strange manifested itself. This seemed to be a pattern of markings unique in the observational history of the planet. It took the form of a dusky patch, irregular in form, located close to the sub-solar point. Running in from the terminator towards this feature Lowell detected thin spindly streaks of shadow, the impression formed being likened to the hub and spokes of a cartwheel.

The reaction to Lowell's announcement was as predictable as it was inevitable. "Illusion" was the cry, and hostile comment followed. So much so that in 1903 Lowell admitted he may have been mistaken. Others like E. E. Barnard and E. M. Antoniadi were forthright in their

rejection of the system, and openly declared Lowell was deluded.

And there, matters rested until 1927. In June of that year F. E. Ross took advantage of the exceptionally favorable eastern elongation, and on twenty-five nights in as nearly an unbroken series as practicable imaged the planet in ultraviolet with the 60 and 100 inch reflectors at Mount Wilson. Details on the disk interpreted as cloud structures were found to be always present on images taken in the ultraviolet. Weak features appeared in the blue and blue-violet. No detail was registered in the red and infrared. Significantly the series gave credence to markings reported by visual observers, including the bright polar hoods Franz von Paula Gruithuisen had discovered in December 1813. Nevertheless Ross did not follow up his findings and it was left to the Frenchman Charles Boyer who imaged Venus in deep-violet in 1957 and discovered a four-day period of rotation in the upper atmosphere, to look beyond the apparent. Even then professional investigators were only convinced when Mariner 10 flew past Venus in 1974.

Meanwhile in spite of corroborative observations by J. Camus (1930), R. Barker (1932 and 1934), A. Danjon (1943), A. Dollfus et al Pic du Midi (1945 - 1956) and R Baum (1953), the Lowellian markings still attracted scepticism. This was the situation in 1999 when Frank J. Melillo obtained CCD/UV images of a pattern of markings on the gibbous disk which consists of a dark central spot with radiating bands or streaks of similar tone. These images raise many questions, not the least of which is; 'Has Percival Lowell's spoke system on Venus finally been imaged?'

## **Analyzing the Observations**

As previously remarked, Lowell's markings are widely dismissed as illusions. Did he not see comparable features and patterns on other planets and satellites? Of course, this is correct, but the assumption is too simple. Each

case must be examined according to individual circumstance, not in the context of a broad canvas. For what is applicable to one instance is not necessarily true of the next. The most famous example that comes to mind is that of the discovery of Neptune in 1846. The Frenchman LeVerrier adopted a certain strategy based on supposedly irrefutable principles, which he then applied to the seemingly intractable problem of Uranus and its irregular motion. A notable triumph followed, one that emphasized the truth of Newtonian theory. Yet in the similar case of the runaway perihelic movement of Mercury, the innermost planet, the outcome was vastly different. But out of failure something else emerged, something that opened new horizons and refreshed science in a most unexpected manner. And so it is with Lowell and his strange Venus markings. The outcome is less epoch-making but is no less important. Lowell believed in the objectivity of what he saw and had every right to do so. But what may be said of effect is invalid for cause. Here we enter the realm of inference and speculation, and there is no assurance. Each observer sees after his or her own fashion, and draws according to his or her personal edict. That however, is not to specify the essential truth of what is perceived.

The fact neither Mariner 10 or Pioneer Venus showed any trace of the spoke system may be critical. However it is important to demonstrate that what Lowell saw with the Flagstaff refracting telescope is basically Y-shaped; but what is that character? It is nothing more than a hub and spoke system? So did Lowell see the well-known Y-shaped formation which is so prominent a feature on UV imagery of the Venus atmosphere? Sceptics will categorically deny the possibility, stating that human vision is not receptive to UV, and that glass is opaque to UV. However neither of these statements are strictly correct. It is now acknowledged that some humans are sensitive to shorter than average wavelengths. It is also known that some types of glass, depending on thickness

and other qualities, are not wholly opaque to the UV.

The following is a personal statement by Frank J Melillo:

“It all started when Venus shone brilliantly in the sky during the evening apparition of 1998-1999. I always have interests doing ultraviolet light imaging with the CCD camera. I had a chance to start in January 1999. But it wasn't until March when Venus was beginning to show some dusky features on the disk. I continued to do a routine observation in UV light. On April, 25th, it was just a clear evening and I was surprised that the view was nearly excellent. I went ahead to spend some time imaging. The very first image already showed something unusual about the dusky features. It looked interesting and I have never seen such dark markings before. I took several more shots until Venus was too low for UV imaging. The light had retired.

“The next clear night which was April 28th, some dusky regions were seen, but not as much. But again, on April 30th, there were some unusual markings similar to the night of the 25th. I might have detected the rotation period in the upper atmosphere! These were the same features as five days earlier. So, I suspected a five-day period instead of a four-day. But a four-day period had already been confirmed by the spacecraft Mariner 10 and by Charles Boyer. According to my images, these features seemed to consist of a broad band with a dark center and with rays around it. It was an interesting week to image Venus. But I continued to image it throughout the months of May and June. I never came across the same features again. After the evening apparition was over, all I knew is that there was something unusual about the markings during the last week of April. This interesting feature was unnoticed or wasn't recognized for over a year and a half.”

Most observers who saw these images failed to recognize the true identity of the features. Nobody knew anything more until December 2000 when Richard Baum saw these images, shown in Figure 1. He has observed Venus nearly his entire lifetime and instantly recognized what others had missed. He had first observed radial markings in 1951 and was as surprised as anyone else at the impression.

Has the visibility of the spoke system something to do with ultraviolet sensitivity? The peak spectral response of the human eye is around 550 nm. Still, we can see clearly on either side of the peak. But there is a limit here. Our eyes can only see certain parts of the wavelength. Generally, there is a cut-off at 700 nm at the red region. We cannot see well beyond which is considered the near-infrared region. At the other end, we cannot see much shorter than 420 nm which is considered as the violet region. In this case, we are talking about ultraviolet light which is shorter than 400 nm. There is a certain population in this world able to see quite well into the violet part of the region. In addition, people who have plastic implants after cataract removal often find they can see even further into the violet region, i.e., the ultraviolet. This is not to say the people who have cataracts removed can see UV easily. But the chance is improved. Now, in the case of Venus and its radial markings we are considering whether or not there are people who can ordinarily see ultraviolet light, i.e., from 400 nm down to around 320 nm. Perhaps Percival Lowell, Richard Baum and others may be normally UV sensitive.

When it comes to Venus, most observers usually see a blank disk. The dusky markings are there but the contrast is extremely low. Even though a filter that transmits UV is used, our eyes are simply not sensitive enough to see anything. The reason why Venus shows markings in the UV region is because of the sulfur dioxide. It is a UV absorber in the upper atmosphere. So, the markings appear darker and the

contrast increases to the point where we can see the outline. Perhaps people who have UV sensitivity may be able to see features on the disk. But the real problem here is the widespread misconception about the possibility. If the many who are unable to see deeply into the UV cannot see the alleged markings then they are highly suspicious from the start, and remain so irrespective of whatever evidence is placed before them. This is only correct. It is a matter of faith to accept what others claim but which the majority cannot verify at firsthand. And as we know faith is notoriously fickle. So naturally the claims of the minority are discarded as unreliable.

While we note there are some people who can see into the UV, what about lenses and mirrors? Are they opaque to light in UV? Some telescope manufacturers claimed that they cannot transmit ultraviolet light because the lens/mirrors usually absorb less than 400 nm. Percival Lowell used a large refractor, Richard Baum used one of much smaller aperture. But now it is recognized that some glass does transmit a small percentage of UV (just under 400 nm with or without special coatings). The aluminized reflector can reflect a certain percentage of UV. The best wavelength to see the markings on Venus is about 360 nm. Therefore it is possible people with UV sensitivity may just see the radial pattern at the threshold of vision with any type of telescope!

Now we consider the effect of the atmosphere. We all know why the sun turns orange and red when setting - scattering of the short wavelength radiation. Thanks to the ozone layer the atmosphere blocks much of the UV and so we are protected from its dangerous excesses. But if we learn not to stay too long in the sun, it is also true that the UV that does sneak through causes us to burn. Therefore, part of the UV light does make it through to the ground, chiefly when the angular height of the sun is high. Venus works the same way. Its markings are slightly more obvious if the planet is

observed at high angular altitudes. Therefore given their extreme faintness it follows that the Lowellian markings far from being spurious, may in fact represent a glimpse of the underlying reality, which distorted by factors of physiology, and optics, is communicated as a crude caricature, in much the same way a child depicts a human face. A social contact simply but effectively expressed in a context of curves and linear expressions which instantly convey a recognizable impression of reality.

Venus can be easily photographed with any filter that transmits UV light. Some films are UV sensitive, but the exposure time has to be increased considerably so there is a good chance the image will be smeared by poor seeing conditions. Thus the CCD camera is more appropriate for this type of work. With a short exposure, you can actually 'freeze' the image. The chip of the CCD camera has a broad range of spectral sensitivity from UV to infrared. Melillo has a Starlight Xpress camera with 'extra' blue sensitivity.

### **The Last Week of April 1999**

Frank Ross and Charles Boyer took a giant step forward but, unfortunately, Ross did not follow up his results, and their significance was not fully appreciated until Boyer discovered the super-rotation of the upper atmosphere in 1957.

In the last week of April 1999, Melillo obtained images of Venus unusual for their depiction of what appear to be radial markings and what may be 'The Eye of Venus', a duskiness sited at or near the sub-solar point. So far as can be ascertained these images are unique in their representation. The images of April 25th and 30th were taken at a low resolution in which shows the greatest contrast, and heightens the impression of a spoke system. Resolution played an important role here. Pixel size is 0.5 arc sec about the limit of resolution of the Celestron 8-inch telescope. The apparent angular diameter of Venus was between 15 - 16 arc

sec., therefore about 30 to 32 pixels across, large enough to reveal the coarse UV details. At higher resolution or from the spaceprobes, the resemblance to the earth-based view as pictured by Lowell would be lost.

Atmospheric conditions were almost perfect, and diffraction effects minimal. Major disturbances shown were sufficiently contrasty to suggest the possibility of detection in visual wavelengths. This suggests a unique moment, that at any other time the radials would not have been registered. In brief a rare observation indeed!

### **Conclusion**

Has Lowell's Spoke System been imaged? Perhaps. The most likely explanation is that Lowell saw the classic "Y" pattern. This was imaged by Mariner 10 and Pioneer Venus Orbiter (PVO) as well as by earth-based observers. Melillo's images show a possible "Y" pattern sideways with three branches to the terminator instead of two. Those branches appeared as "spokes" and radiate from a conspicuous dark spot. One more branch stretches out to the limb. As a "Y" is a spoke system with three radials, this could, under indifferent seeing give the illusion of a cartwheel. This is probably what Lowell saw at low resolution.

At the time of observation contrast was high. This suggests the pattern could have been faintly visible in visual wavelengths. Low resolution work is capable of revealing such patterns. At high resolution or from the spacecraft, the pattern would be smeared or diffused and be lost, and not reconcilable with the low resolution impression.

The logical conclusion is that Lowell like others since, glimpsed the underlying truth of the Venus markings, but influenced by various factors distorted its reality, in much the same way as a child schematizes a human face. The representation has little resemblance to reality, yet in the figuring of mouth, nose, ears, mouth



and eyes there is truly a presentation of truth. The crux of the matter thus appears to be that the limit of human ability to see into the UV falls - by coincidence - at just about the point where the UV markings begin to appear. If that is so some very interesting consequences flow from it that have direct relevance to visual observation in general.

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## **A Prime Opportunity to See the "Ashen Light" of Venus**

**By Mark Gingrich (grinch@rahul.net)**

For more than three centuries, ever since the Italian astronomer and cleric G. Riccioli first observed and sketched it in 1643, a convincing corroboration of the ashen light on Venus has yet to be made. Is it indeed an actual planetary happening? Or is it merely an illusion?

The ashen light's enigmatic status has been sustained over these many years by a grand conspiracy of real-world circumstances: a stark contrast between the sunlit Venustian cloud canopy and its nighttime side; the unavoidable scattering in the optical path of Venus light by air and aerosols above the telescope, and by imperfections in our telescopes, not to mention diffraction effects in same; the inherent limitations and finite dynamic range of our detectors, be they photographic emulsions, CCDs, or human eyes; and with regard to this latter sensor, a susceptibility of the eye-brain system to mirages of the psychophysical kind. No wonder controversy has reigned for so long. Yet it is embarrassing to admit, now several decades into the interplanetary spacecraft era, that we still don't know.

But a way to resolve this issue, definitively, later this year, by way of a rare and splendid observational opportunity occurred only this summer.

On 17 July 2001, the waning crescent Moon occulted the 68-percent-illuminated disk of Venus. The disappearance event was just a warm-up act; it was Venus's reappearance from behind Luna that is the more noteworthy performance, because that's when the planet's leading, nightside edge emerges from behind the dark (albeit faintly aglow in earthshine) lunar limb. Here was a chance -- admittedly brief, of no more than a dozen seconds or so -- to look for the elusive ashen light while avoiding the dazzling glare of Venus's sunlit portion.

Clearly, if Venus's disk was discerned just before egress of its bright edge, that would constitute a compelling, positive data point bolstering the case for the Venustian ashen light. Moreover, a quick-and-dirty assessment could be made of the ashen light's surface brightness relative to the level of earthshine for that particular lunar phase (13 percent illuminated).

## ALPO Feature: The Moon

### Observing for Lunar Flashes: Spurious vs. Real Signals

By Eric Douglass, Francesco Badalotti, Giacomo Venturin, Raffaello Lena, and Guido Santacana

#### Basic Impact and Cratering Mechanics on the Moon

Surface impacts consists of three phases: compression, excavation, and modification. However, only the compression phase interests us in this paper because this is the part that generates the flash. In the compression phase, the kinetic energy of the impacting body is transferred to a shock wave. This kinetic energy is proportional to the square of the impactor's velocity. The velocity of impacts on the Moon is the sum of the escape velocity (2.4 am/sec) and the approach velocity which can vary considerably: 10-20 km/sec for asteroidal meteorites; 20-25 km/sec for short period comets, and 40-60 km/sec for long period comets. The velocity of planetary impacts, and therefore their energy, is generally quite high. Indeed, this shock wave produces pressures and temperatures that are sufficient to vaporize most if not all of the impactor, plus a mass of lunar material which is several times the mass of the impactor. The pressures involved are in the range of several hundred GPa (1 GPa = about 10,000 atmospheres), with temperatures in the range of 5,000-8,000°C. It is this initial vaporization that produces the "flash" seen by observers of an impact.

After initial contact, the shock wave propagates in a hemispheric geometry through the lunar surface and rearward through the impactor itself. As the shock wave dissipates, the lunar materials undergo less energetic events, such as wholesale melting of rocks and diaplectic glass formation. Following the shock wave is a release wave (called a rarefaction wave) begins at the free surfaces and sets

material in an outward and upward motion. These events produce the excavation of the crater's cavity.

The question now remains as to the time frame for the flash. The duration of the initial compression from the shock wave is  $L/V_i \times \sin \theta$ , where L is the meteor's diameter,  $V_i$  is the velocity at impact, and  $\theta$  is the angle of impact with respect to the normal surface (Melosh 50). Thus, for a 1 meter meteorite traveling at 20 km/sec and striking the moon perpendicular to the surface, the duration of the compression phase is  $5 \times 10^{-5}$  second. The following rarefaction wave moves at an even higher velocity than the shock wave. Thus, the time involved in compression phase, up through the creation of ejecta that is at its highest temperature, is only a fraction of a millisecond. However, this initial "flash" is not visualized, as it is encased in a shell of slightly cooler material called the "vapor plume." The earliest part of the vapor plume is composed of vaporized target materials, and this material absorbs much of the radiative energy from the hotter materials below (Artemieva, et. al.). Modeling of small impactors suggests that this 'envelope' becomes optically thin over the first tenths of a millisecond, so that the maximum in visible radiative energy occurs at  $4 \times 10^{-4}$  second after impact. This rapidly decreases, by an order of magnitude in the next  $6 \times 10^{-4}$  seconds (Artemieva, et. al.). Thus, the times involved in the "flash" of a small meteorite occur is a time frame so short that it is nearly impossible for one to occur on more than one frame in a video sequence.

The instrumentation left on the Moon from the Apollo missions revealed the size and frequency of impacts on the Moon. During the years of their operation, they showed that

approximately once a year a mass of at least one metric ton (1000 kg) strikes the Moon. Since the flashes that have been observed from Earth are more frequent than this, we can safely assume that most are from much smaller impacts. However, making certain approximations for density and velocity, we can suggest that chondrites of one metric ton mass will produce craters in the range of 15 to 40 meters in diameter, which are well below the resolving power of Earth-based telescopes. Consequently, the flash from these impacts will be a point image and may only be seen because of its extreme contrast against the background, much like stars which are also below the spatial resolution limit of our eyes.

## **Visual Observations**

Any photosensitive device, such as the eye or a camera, can detect flashes. As a receptor, the human eye is sensitive to a very narrow band of the electromagnetic spectrum and, thus, are not subject to errors produced by other forms of radiation such as cosmic rays and some lighting issues such as internal reflections. In addition, with the ability of the human brain's ability to discriminate between light sources, the visual observer can screen out many forms of interfering external lighting such as flashlight reflections. However, the human observer is subject to various visual errors, such as seeing ghost images after looking into a bright light, creating the illusion of a flash because they want to see it, and, for the observer who wears glasses, reflections from these. Thus, while the human observer is an excellent detector, they also have problems with reliability, and no means of checking their results since events are not recorded for further examination.

The visual observer can take a number of actions to address these problems. The easiest and most effective is to observe in a group, especially a group which is also using recording devices. A flash visually recorded by one observer working alone is always suspect,

while one recorded by multiple observers armed with watches for coordination is much more difficult to refute. Next, the person can prepare for observing by taking the time to dark adapt their eyes which will make their detector as sensitive as possible. Also, the observer is advised to stand at some distance from any interfering lights. Looking into a light and then looking at the darker Moon may produce 'ghost' images that could be mistaken for a flash. Finally, the visual observer who wears glasses may consider observing without them, if the observing site is not truly dark.

Based on this information, our suggestions for visual observers are as follows:

- Observations must be made in darkest site possible, for the maximum contrast. Flashes from impact mechanisms are always below the resolution limit of the eye, and so it is only contrast that makes them visible.
- A 30-minute period of dark adaptation should precede the observations.
- Avoid wearing glasses.
- No flashlights, even red ones should be used!
- If the Moon is illuminated, and you are observing the dark side, use blocking device, such as a black hood over the head, to block the Moon's light.
- Use eyepieces with the best antireflection coatings available.
- Use a network of visual observers and, where possible, CCD video imaging.
- Don't use any type of filter, no matter how slight it may be.

## **CCD Video Imaging**

The most ideal imaging tool for lunar flashes is the low-light astronomical CCD video camera. This allows the observer to make a permanent record of lunar flashes, which can be examined by researchers at a later date. However, a variety of errors can be introduced into the video system, and an understanding of these first requires an understanding of the video signal.

The "signal" of a CCD image refers to the electronic readout that would be expected to be proportional to the number of photons recorded by each pixel. While it might appear that a certain number of photons should produce a certain level for that pixel, this is not always the case. The reasons all have to do with noise, which is the random variation in the signal. The various sources of noise can be summarized as follows:

- **Readout Noise:** when the signal generated by light falling on a CCD is collected, amplified, and converted to a digital value, noise is introduced at each step of the process.
- **Dark Count:** in the absence of light, electrons accumulate in a CCD and this signal is indistinguishable from one produced by light.
- **Background Noise:** the sky background produced by moonlight or light pollution contributes to the signal collected by a CCD.
- **Non-Lunar Light Falling on a Chip:** here the primary concerns are not just reflections, but spurious flashes produced by cosmic rays.

### Imaging the Spurious Flash

In order to further examine and characterize spurious flashes, the Geologic Lunar Research group initiated a study. We used a dark test, where two video cameras at different locations recorded dark images through telescopes. Since these were dark tests, any signal received would be defined as a spurious flash. Next, the two video images were compared to ensure that the flashes did not occur on both tapes.

Examination of our tapes revealed seven flashes that were recorded during a dark test, and were not recorded on the other videotape. These are recorded in Table 1 below. Also recorded in this chart are the signal to noise ratios of the significant flashes.

Table 1: Typology of Spurious Flashes

Test	Duration (Minutes)	Number of Significant Flashes	Multiple Points (# of Flashes)	Segments	Faint Flash	S/N Ratio of Significant Flashes Only
A	60	1	100	0	7	6.6
B	128	0	60	1	0	
C	30	2	20	10	5	5.6 and 5.5
D*	60	0	80	0	10	
E*	60	1	2	1	4	7.0
F	128	2	5	0	1	6.4 and 5.1
G	60	1	3	1	0	4.6
NOTE: An asterisk (*) denotes results obtained by observers in different locations at the same times.						

The S/N ratio was calculated by measuring the distance between the peaks and troughs in the non-flash sections of the tape. The signal then was the height of the flash above this mean noise level. The S/N ratio was then calculated by dividing the measured signal by the measured noise.

Examination of the images revealed four types of spurious flashes: single point flashes, multiple point flashes, segment flashes, and faint flashes. These are characterized below:

- **Single Point Spurious Flashes.** These are flashes that occur in a single point in the dark test tapes. Their profiles are all similar. A photographic image of one such flash is shown in Figure 1 and its brightness profile in Figure 2. Causes for this type of spurious



Figure 1. Dark test showing a single point spurious flash.

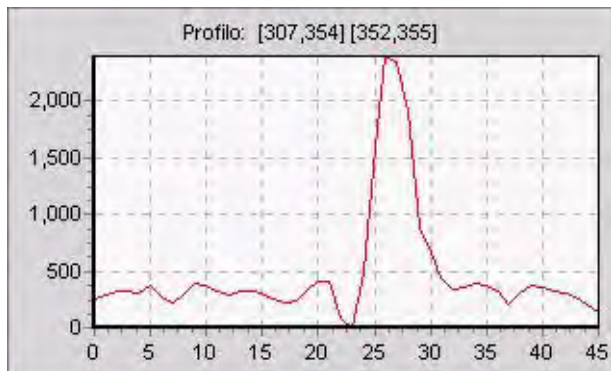


Figure 2. Profile of single point spurious flash.

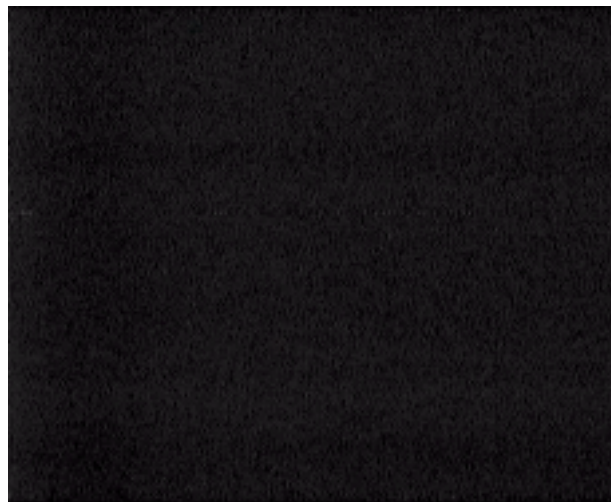


Figure 3. Multiple point spurious flashes.

flash include cosmic ray interaction with the chip, as described below in 'Segment Spurious Flashes'.



Figure 4. Segment spurious flashes, probably caused by cosmic rays.

- **Multiple Point Spurious Flashes.** These are flashes that appear as a series of separate points in a horizontal line. The photographic image of one such flash, along with its profile, is shown in Figure 3. This kind of spurious flash occurs when the first pixel is found more luminous with respect to following pixel (it is the sum of the two). The following pixel is found black because it is empty. This defect can happen more often in a defective reading cycle.
- **Segment Spurious Flashes:** These are flashes that are connected in a single, horizontal line. The photographic image of one such flash, along with its profile, is shown in Figure 4. We suspect that this type of flash is caused by a cosmic ray. Cosmic rays represent high energy particles generated outside of our solar system. They normally interact with molecular species in our atmosphere, producing showers of secondary particles. We believe that these showers produce the segments that we have recorded.
- **Faint Flashes:** These are flashes that have low S/N ratios, and probably represent a noise peak. Their extreme faintness suggests that they are due to effects from electronic components, tapes, or the recording VCR. Examination of faint flashes reveals that their S/N ratio is almost always equal to or



Figure 5. An unconfirmed lunar impact flash from the Perseid swarm (point 4), a meteor flash in the atmosphere ("meteora") and several possible spurious flashes and stars.

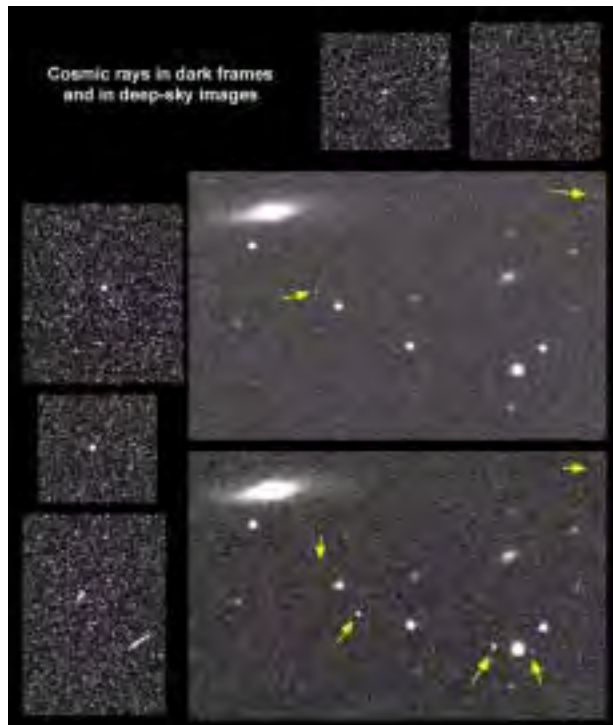


Figure 6. Spurious signals, probably due to cosmic rays, in deep sky CCD images.

less than two standard deviations for that of the measured noise. Given this, we suggest that the standard be adopted that significant flashes are greater than five standard deviations. This should rule out the faint spurious flash. Unfortunately, this standard will also rule out faint 'true' meteor flashes, unless

they are confirmed by a second, distant observer.

Finally, we include Figure 5 which contains an Earth-bound meteor flash, a lunar impact flash (unconfirmed event from the Perseid swarm), and several single point spurious flashes. Luminosity profiles of the impact flash and the spurious flashes were indistinguishable from each other.

The image shown in Figure 6 was taken by Lorenzo Comolli (Italy) with an HiSIS33 camera, (at  $-25^{\circ}\text{C}$ ) fitted to a SCT 20 cm. The white spots with an arrow probably originated from cosmic rays. These spurious signals are similar to those of stars. Similar signals were obtained by Comolli with dark frames (such as single spots and linear segments). It is significant that the profiles of the star, the actual lunar impact flash, and the single point spurious flashes are similar enough to be indistinguishable. Fortunately, this is only true for the single point flashes. The multiple point spurious flashes and segment spurious flashes all have significantly different profiles that are distinctive and can easily be separated from the lunar impact flash.

Because spurious flashes can occur due to the various reasons listed above, it is clear that a videotape of a flash, which is restricted to a single frame on one single videotape, is insufficient evidence to prove that a lunar impact has occurred. It is only suggestive. Confirmation requires a second observer/recorder. Because some observers separated by small distances can see the same spurious flashes, such as the glint off a satellite, it is suggested that these observers be separated by a minimum of 20-30 km.

## Conclusion

From this paper, it is clear that either visual or videotaped observations may record spurious flashes. Thus, for confirmation of a lunar impact flash, it is required that two observers/

recorders, who are separated by a minimum distance of 20-30 km, have evidence at the same time for the event to be considered valid. In addition we have outlined a variety of suggestions for the elimination of spurious flashes. Finally, we have shown that, for video taped observations, certain profiles are characteristic of spurious flashes.

## **Acknowledgement**

We acknowledge Lorenzo Comolli for the contribution to this paper. We would like to thank Prof. Giancarlo Favero for his help in the statistical analysis of this paper and for his stimulating discussions.

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## **Mission Statement: A Vision of Lunar Impact Research**

Since the first confirmed lunar impact observation of 18 November 1999, an exciting area in observational astronomy has re-opened. Attempts were made to observe meteor hits on the Moon in the 1940's, '50's, and 60's, but none of the many impact candidates observed during this time have been independently confirmed. Watching lunar meteors involves observing the visual signatures (i.e. flashes) of things hitting the Moon, phenomena that may be a bit more common than once thought. It takes only a small telescope or even binoculars to reveal evidence of copious amounts of impact events that have happened in the past. However, it is not until this present age that such an event has been witnessed and confirmed as such. Several instances have occurred in the past where single observers have witnessed what were likely meteoritic impacts on the moon. The famous case of the 12th century monks is one example, with the possible evidence in the form of the crater Bruno; more recent examples include Dr. Leon Stuart's Lunar Flare of 1953 and several reports of lunar transient phenomena in the form of flashes, lights and other events. What a fitting time, at a point where the vast majority of the population considers the changing of the millennia, that a pioneering new field in observational astronomy is birthed.,

**ALPO Feature: Mars**

**An English Language Translation of M. Camille Flammarion's  
'Phenomena Observed on the Planet Mars'**

**By Ted Stryk**

**Introduction**

Camille Flammarion certainly left his mark on late 19<sup>th</sup> and early 20<sup>th</sup> century Mars studies, compiling massive volumes containing compendiums of previous data from the previous three centuries. A child prodigy, his place in science was seldom if ever questioned. However, he was also known to have an unmistakable bias toward the idea that life existed on other worlds. He became a staunch supporter of Percival Lowell and his canals, which purportedly were built to sustain a dying civilization being parched by a planet which had lost most of its water. (2)

However, this document which I have translated here indicates that Flammarion did not evaluate Lowell's ideas on their own merits; rather they conveniently solved a problem in his view of an Earthlike Mars. Written in 1873, it was before Schiaparelli's 1877 observations which began the canal controversy (1). And here we find Flammarion noting the lack of seas on Mars compared to the Earth. The idea that there was a water crisis on Mars thus would have appealed to him -- his Martians, like Lowell's, were short on water, and thus canal builders. This solved the problem of a life-filled Mars with less water -- Mars was drying up, and efforts were being made to counter it. Thus, Flammarion's unquestioning acceptance of Lowell may be largely ascribable to the model's ability to solve the problems of Flammarion's Mars, rather than convincing evidence or scientific merit.

It is also rather amusing to read the six statements on Mars at the end of the article, originally a presentation to the French Academy of

Sciences, which are held as confirmed fact, and have now been thoroughly reputed for the most part, although some portions, and even the idea of life on Mars, have reemerged in recent years, though in completely new forms and using information entirely unavailable to Flammarion. It is particularly amusing to read the ideas such as that the red of Mars was caused by red vegetation, or to read that water was in the same state as on Earth. But the expansion and recession of the polar caps was beginning to be understood.

The following is a translation that has been edited a bit for clarity and word use, but I tried to stay as faithful to Flammarion's French text as possible.

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*Phenomena Observed on the Planet Mars  
Institute of France  
Communication of M. Camille Flammarion*

*Extract of a report from a session of the Academy of Sciences July 28, 1873*

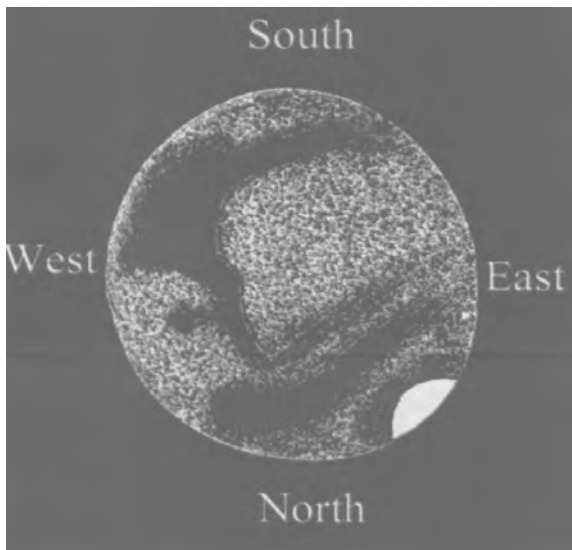
During the period of opposition that it passed, the planet Mars presented us its northern hemisphere that is less known than its southern hemisphere. The north pole was heavily inclined towards us. It is in position to reveal to us brilliant white spots which in certain conditions of atmospheric transparency, seem to exceed the outline of the disk.

This polar skull cap is not actually very expected; it sometimes offers the eye the impression of a white pea that scintillates on the inferior limb of the disk, and its position indicates that the pole finds its way to the environment of 40 degrees of the inferior extremity



of the vertical diameter, in the direction of the east (the image is reversed in the astronomical lens). The north pole snows do not actually extend beyond 80 degrees of areographic latitude. It is known that it is sometimes overcast, which is quite considerable, since in certain years, it overtakes 60 degrees. The variations of the southern snows are even larger.

There is probably a polar sea around the north pole, because a dark marking there is constantly visible, that is to say when the rotation of Mars brings that face around to us. This polar sea seems to extend as far as towards even 45 degrees at certain points, but it exercises to rage in two expanses of land that extend 65 to 75 degrees. What that is to say is that this intermediary land that is hardly distinguished, the sea extends, on the other hand, as far as the ice, that is to say as far as less than 80 degrees, and the other part as far as 45 degrees.



View of the Planet Mars, June 29, 1873 at 10 p.m.

A sea shaped like the Mediterranean Sea, very long but tightly short in north-south dimensions, and rejoining a vast sea that extends beyond the equator in the southern hemisphere. Between the extremities of this Mediterranean and the polar sea of which I have come to speak, there are other enigmas. Ordi-

narily, this Mediterranean-like sea seems to pass to combine the first two spots. Sometimes one thinks one distinguishes in the northern extremity a solution of continuity, and the same returns to a right angle. Whether or not the Mediterranean-like sea connects with the polar sea does not rule out the general description of it that I have given: a North pole marked by a small, wide extremely white spot, with a trickle of water. It is understood in this sense the extreme southern latitudes are considerable.

Mars is actually in the season of autumn in its southern hemisphere. The bigger part of the northern polar snows are melted while they pile up at the south pole, invisible to us. The south region is visibly marked by a white streak close to the edge. Does the snow extend as far as 40 degrees of latitude south? It is a big problem due to clouds.

The detailed study of this planet shows that its surface is quite different than Earth's terrestrial surface, especially in the ratio of land and seas. Among ours, three quarters of the globe are ocean. However, the evaporation produces effects analogous of this constitutes terrestrial meteorology, and spectral analysis shows that the atmosphere of Mars is loaded with water vapor like ours, and that these seas, these snows, these clouds are really composed of the same water that our seas and our weather acquire.

It seems that the red of the continents is less intense this year than in general. One often controversially explains this coloration accessing those that attribute it to the atmosphere, but that explanation is rejected, since it is constant on the borders of the disk of the planet are less colored than the center, and are almost white. This grips the contrary if the coloration is due to the atmosphere, because it grows at the rate of thickness of atmospheric transverse by which the rays reflect. Is it due to the color of the materials constituting the surface of the

planet? One is able to admit, if the reason of analogy we engage in has the continents of Mars, it does not have to stay in the sterile deserts, but that under the influence of the atmosphere, the rains fertilized by the sun and of the elements that bring on Earth the production of the world's plants, they have to cover also any vegetation, and yield with the state of physics and chemistry of the planet.

If the red color is not due to the exposure of the interior of the soil, but rather is on the surface, it can be said that the red colored areas are those covered by Martian vegetation. It is true that the seasons of Mars look pretty close to the same intensity as ours, one does not see the variation of shades corresponding to those one observes with the seasons below our terrestrial latitudes, but the vegetation that patches the surface of Mars is to be less strongly different than ours and suffer less variations in the course of a year.

It can be said that the studies made on the planet are similarly numerous now to permit us to form a general idea of its geography and its meteorology.

We are now able to provide hard facts on the astronomy and physics on the knowledge of this planet.

1. The polar caps are alternatively covered with snow according to the seasons, and according to the variations due to the strong eccentricity of the orbit. Actually the ices of the north pole don't go past 80 degrees.
2. The clouds and atmospheric currents exist there like the Earth; the atmosphere there is very busy in the

## Nicolas Camille Flammarion (1842-1925)

Nicolas Camille Flammarion first studied theology, but got interested in astronomy also early on. At the age of 16, in 1858, he wrote a 500-page manuscript, *Cosmologie Universelle*, and became an assistant of LeVerrier (the man whose calculations had led to the discovery of Neptune) at Paris Observatory. From 1862 to 1867, he temporarily worked at the Bureau of Longitudes, then returned to the Observatory where he became involved in the program of double star observing. This project resulted in publishing a catalogue of 10,000 double stars in 1878.

Besides this, Flammarion also observed the Moon and planet Mars. He published several popular books (*L'astronomie Populaire* in 1879, of which over 100,000 copies were sold and an English translation by [J.E. Gore](#) appeared in 1894, as well as a book on Mars, supporting the existence of "canals", built by an advanced civilization), and encouraged amateur astronomy. In 1877, Flammarion founded the Astronomical Society of France. In 1882, he was donated a private observatory and estate by a M. Meret who admired his work.

In 1922, he was made a Commander of the Legion of Honor for his astronomical life-work.

In 1921, Flammarion added [M104](#) to the Messier catalog. He had found [Messier's](#) handwritten position in his personal copy of the catalog, which he happened to possess. M104 could be identified with [William Herschel's](#) H I.43 or NGC 4594.

winter and summer.

3. The surface of Mars is more equally divided than ours into continents and seas; there is a little more land than sea.
4. The meteorology of Mars is very similar to that of the Earth; the water there is in the same physical and chemical conditions as on our globe.
5. The continents appear covered in the red vegetation.
6. Within the limits of this analogy, the organic conditions on Mars resemble those which manifest themselves on Earth more than any other planet.

(July 28, 1873)

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**ALPO Feature:**

**The Minor Planets Section of the ALPO**

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

The primary aim of the ALPO Minor Planets Section is to provide a medium for information exchange and publication of results among professional and amateur astronomers to advance all studies of minor planets. This is achieved through the publication of the quarterly *Minor Planet Bulletin* (the “MPB”) and a number of internet activities detailed below.

The section leadership as well as the readership includes a wholesome blend of amateur and professional astronomers. Coordinator Frederick Pilcher, Associate Coordinator Lawrence Garrett, Assistant Coordinator for Observations of Near Earth Objects (NEO’s) Richard Kowalski, and Subscription contact and distributor Derald D. Nye, are all amateurs. MPB editor Richard P. Binzel, publisher Robert A. Werner, and Scientific Advisor Steve Larson are all professionals. Papers to the MPB are contributed by both amateur and professional astronomers.

Our members engage in a wide variety of minor planet studies. CCD astrometry, with special emphasis on follow-up astrometry of newly discovered NEO’s, is done by many people and the results generally forwarded to the Minor Planet Center of the Smithsonian Astrophysical Observatory rather than published in the MPB. It is generally recognized that except for some of the lower-numbered more frequently-observed asteroids, the published absolute magnitudes contain many errors, a few as large as one or two magnitudes.

Visual as well as CCD photometric observers noting magnitude discrepancies report them to Lawrence Garrett who leads the Magnitude

Alert Program (MAP). Gerard Faure is the European manager of the MAP program. E-mail messages are immediately sent to all contributing observers, leading to follow-up and confirming observations. CCD and visual magnitude measurements by experienced observers are usually consistent within 0.3 magnitude, indicating that this is a scientifically useful activity for visual observers.

The MPB actively supports photometric light-curve studies, and publishes in each issue several lightcurves and derived rotation periods and amplitudes. This is a field which is wide open for CCD observers able to reach magnitude 13 or fainter with an accuracy of 0.04 magnitude or better. Indeed, any accurate asteroid lightcurve of several hours’ duration is eminently publishable.

Several hundred asteroids already have published rotation periods and amplitudes, and thanks in part to observers in the Minor Planets Section, this list is growing steadily. Thousands more, including NEO’s, are still unstudied, and when new lightcurves are made of old asteroids the rotation parameters can be improved. In some cases new photometry shows that previously published periods were incorrect.

A nagging problem throughout the entire half-century of photometric study of asteroids involves asteroids whose rotation periods are simple fractions of the Earth’s ( $1/3$ ,  $1/2$ ,  $1/1$ , etc.) In this case, the same part of the light-curve is seen night after night by a given observer, with the rest of the lightcurve unknown, and often the rotation period itself ambiguous.

The Minor Planets Section is organizing a cooperative program wherein observers at

widely different longitudes, especially in Europe and North America, target the same asteroid to remove the missing part of the lightcurve and the ambiguity in period.

Opportunities for especially useful or interesting observation are regularly published in the MPB. These include close mutual approaches of minor planets and appulses of asteroids to bright stars, both found by E. Goffin; and to deep-sky objects, found by Brian D. Warner; asteroids much brighter than usual at a forthcoming apparition due to having eccentric orbits and approaching the Earth more closely than usual, found by F. Pilcher; and photometry opportunities for asteroids especially in need of lightcurve work, as determined by P. Pravec and A. W. Harris. Also, B. D. Warner routinely prepares finder charts for some fainter asteroids.

Lawrence Garrett also maintains and updates an extensive Minor Planets Section of the ALPO web site, in which MAP and other results are posted.

Persons interested in becoming involved in minor planet studies are encouraged to become members of the Minor Planets Section. Membership consists of a subscription to the quarterly *Minor Planet Bulletin* and is only \$9 U.S. per year in North America, \$13 U.S. per year elsewhere. Inquiries and subscription payments to "Minor Planet Bulletin" may be made to Mr. Derald D. Nye, Minor Planet Bulletin, 10385 East Observatory Drive, Corona de Tucson, AZ 85641-2309 U.S.A., (nye@kw-obsv.org), telephone 520-762-5504. Other inquiries should be made to the section coordinator, Frederick Pilcher, Illinois College, Jacksonville, IL 62650 USA; e-mail to (pilcher@hilltop.ic.edu).

## TITANIA OCCULTATION ALERT

The path of this occultation on 8 September 2001 will be nearly 1000 miles wide, comparable to the diameter of the Uranian satellite, Titania. The sunlike star, #164538, is a G5 with a *bv* of .90. The occultation could last 1.5 to 4 minutes. The star should subtend about .6 milliarcsseconds, and be about a kilometer in diameter at the distance of Uranus.

The best place to observe this occultation will be a line of longitude including eastern Europe and Africa. However, the latitude is still uncertain, but each location will have a 12% chance of seeing a total occultation. It may be possible to see the occultation from all of Europe, most of Asia, and possibly the eastern USA. Someone needs to determine the exact occultation latitudes/occultation path, and this can be easily done in the next few weeks. (This has already been done. See below.)

Any telescope can observe this occultation, if they are in the right path. Uranus will be a month past opposition in eastern Capricornus at Magnitude 5.7 and 3.7" in diameter. The star will be only a third as bright. Titania is normally invisible in telescopes under 12" (30cm) in diameter. However, it is not necessary to see Titania to observe the blinking out of the star.

While occultation timings can be conducted by anyone with a small telescope, useful science can be performed by telescopes 20 cm or larger in aperture, preferably with color filters in several wavelengths, using photometers with time steps of .1-.2 seconds. A few people may try photometry using polarized light. The results might find an extremely tenuous atmosphere for Titania, and high speed photometry could map the star.

Thanks to Walker S. Vaning for this heads-up to the amateur community.

The interest in this occultation is for high speed photometry with a photometer or CCD. This moon is covered with ices and with Uranus entering it's summer these may sublimate off forming a temporary atmosphere. We hope to see this atmosphere in the photometry.

For a plot of the path across the earth, predicted photometric profiles and current updates on the information see the LPL Titania Occultation page at:

<http://www.lpl.arizona.edu/~rhill/planocc/titania.html>

**ALPO Feature: Jupiter**

## **Can the Galilean Satellites of Jupiter Be Seen With the Naked Eye?**

**By Walter H. Haas,  
Founder and director emeritus, ALPO**

### **Abstract**

Favorable conditions likely to be necessary for success in seeing one or more of Io, Europa, Ganymede and Callisto with the unaided eye are reviewed. It is suggested that the best opportunities occur when two or more rarely three, of the Galilean satellites are so close together in the sky as to offer a single merged image to the unaided eye, just as most eyes perceive Epsilon1 and Epsilon2 Lyrae as a single star. Quantitative data on the brightness and maximum angular separation from Jupiter of each satellite and each possible merged image are presented. A few notes are offered about future attempted observations.

### **General Ideas**

Is it possible to see the four large satellites of Jupiter with the naked eye? Is it ever possible thus to distinguish any one of them? My interest in this question was reviewed in 1962 by an article in a popular scientific magazine<sup>1</sup>. While this observational problem is scarcely of basic scientific importance, it may still be interesting enough to satisfy a few rambling thoughts.

The fact that the Galilean satellites remained unknown until the telescope was invented is here inconclusive. Pre-telescopic star catalogues recorded only about 1,000 stars, far fewer than a keen-eyed observer can detect under optimum conditions. Again, W.F. Denning has told us how he watched the motion of Uranus across the star background during his extensive naked-eye observations of meteors?

It is, if possible, even less conclusive when a modern observer announces seeing these moons without a telescope just after seeing them in a telescope -- especially when his or her naked-eye revelation preserves the inverted telescopic image.

My own vision is and was not nearly good enough to enable me to reach a personal opinion. I have heard a professional astronomer dismiss the question with: "Some liars have claimed to see them." I have also been in the company of an amateur who described glimpses of Ganymede or Callisto when near greatest elongation from Jupiter, apparently correctly when a check with an ephemeris was made and apparently without foreknowledge.

The great observational difficulty is, of course, the very close proximity of the far brighter Jupiter. Therefore, one must insist on optimum conditions. An absence of any twilight or moonlight and a very clear sky are obvious needs. Jupiter should be fairly high in the sky - atmospheric extinction relative to the zenith can amount to almost half a stellar magnitude 20 degrees above the horizon. It is also an advantage to have Jupiter near opposition, so that the angular separation of the satellites from their primary is increased, and ideally the planet is near perihelion as well. It is even best if Jupiter is not projected against the Milky Way or the Zodiacal Light. The eye should be fully dark-adapted, and the ingenious viewer may find any sort of occulting bar which conceals Jupiter but not its attendants a tremendous advantage. However, he or she might also need a mechanical tracking device to glimpse an image a few minutes of arc from the limb of Jupiter while the planet moves at the diurnal rate of 15 minutes of arc per minute of time. A minor matter is that the satellites usually show

a slight phase, at quadrature resembling that of the Moon a day before or after Full Moon.

## Concerning Merged Satellite Images

It seems to me that actually the best opportunities for perceiving Galilean satellites must occur when two or more of them are so close together in the sky as to offer a single merged image to the naked eye. This idea can hardly be original, but I am not aware that it has been developed in a quantitative form in the literature. Indeed, the concept is very much like one applied by *Mr.* David H. Frydman of Wembley, Middlesex, England, to telescopic observations of satellites of Saturn.<sup>3</sup> But let us continue: We know that few eyes can resolve Epsilon One and Epsilon Two Lyrae, instead perceiving a single merged image. Yet these two fifth magnitude stars are separated by 3.5 minutes of arc. It will surely be a conservative point of view to conclude that two satellites of Jupiter will present a single merged image to the naked eye when they are within 2.0 minutes of arc of each other. Such approaches will be frequent as the four satellites revolve around Jupiter. Indeed, no Galilean satellite is ever as much as one-half minute of arc north or south of the major axis of its apparent elliptical path in the plane of the sky, thus providing merged images whenever the east - west separation of two or more satellites is small enough.<sup>4</sup> These merged images will recur in periods which are multiples of the periods of revolution of the participating satellites around Jupiter, just like the eclipse saros.

## Quantitative Data

In Table I, we give for each individual satellite its stellar magnitude when Jupiter is at a mean opposition and its maximum angular separation from the center of the disc of Jupiter at that time.<sup>5</sup> We also present data on all possible merged images composed of either two or three Galilean satellites. The brightness of the

merged image is computed from the familiar definition stellar magnitude. With an arbitrary limit of resolution of 2.0 minutes of arc, the center of the merged image is assumed to fall within 1.0 minutes of the innermost satellite in the grouping.

If Jupiter is at quadrature at its mean distance from the Sun, then the angular separations in Table I will be decreased by 21 percent, while the stellar magnitudes will be fainter by 0.41 stellar magnitudes as a result of increased distance.

We are thus asking to see a companion “star” 6 to 8 stellar magnitudes dimmer than its neighbor 2 to 10 minutes of arc away.

## Concluding Remarks

Several ideas may occur to persons interested in this problem. One would be to experiment with artificial stars simulating the brightnesses and separations listed in Table I. The nice use of occulting bars might be found to be critical to success, with positioning to within one or two minutes of arc just about essential to blocking out the glare of Jupiter.

Another approach is purely empirical. Let the energetic observer keep a careful record with dates and times of his positive and negative observations. The observer must know nothing of the simultaneous true configuration of the Galilean satellites; ideally, he should also not know their periods of revolution, nor even how many bright moons Jupiter has. Only after the end of a long series of naked-eye observations should the data be checked against the known reality.

My own opinion is that the easiest event to observe among those tabulated in Table I will be a conjunction of III and IV. Would you care to find out?

## References

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W.F. Denning, *Telescopic Work for Starlight Evenings*, pg. 217, 1891.

Lavid H. Frydman, *Subvisual Points of Light in Saturn Observations*, JALPO, Vol, 9, pp 214 – 219, 1982.

*The Astronomical Almanac, 2001*, pg. F10, diagram of satellite orbits.

Tom Gehrels, *Jupiter*, pg. 994, 1976. The angular separations in Table I have been calculated from Dr. Gehrels' semimajor axes and the known mean opposition distance of Jupiter.

This estimate was derived from various volumes of *The American Ephemeris and Nautical Almanac* by comparing the radius vector of Jupiter near an opposition and its stellar magnitude.

**Table 1: Galilean Satellites at Mean Opposition of Jupiter**

Satellite	Maximum Angular Separation	Stellar Magnitude
I (Io)	2.31	5.0
II (Europa)	3.67	5.3
III (Ganymede)	5.85	4.6
IV (Callisto)	10.28	5.6
I and II	2.31 ± 1.0	4.4
I and III		4.0
I and IV		
II and III	3.67 ± 1.0	4.5
II and IV		4.1
III and IV	5.85 ± 1.0	4.7
I, II, and III	2.31 ± 1.0	4.2
I, II, and IV		3.7
I, III, and IV		4.1
II, III, and IV	3.67 ± 1.0	3.9

NOTE: The stellar magnitude of Jupiter is about -2.36 at a mean opposition.

## Product Review

### The Binocular Viewer

By Richard J. Wessling  
Assistant Coordinator, Instruments Section

Is the binocular viewer a worthwhile addition to your list of viewing accessories?

My experience with binocular viewers convinces me that they are definitely worth the expense. I purchased a very high quality straight viewer from a leading telescope manufacturer and have been delighted with it. I use it on Newtonians, Schiefspiegler and small refractors. However, this accessory may not be for you.

The binocular viewer (also called “bino-viewer”) is useful if you have enough light from your telescope, the object is bright enough and the sky dark enough to perceive the object. The light is taken from your telescope's objective and split into two paths, one for each eye. The effect is like more than half the light, since you are using both eyes to perceive the object.

The viewer I have utilizes a 2x Barlow that can be added to the front of the viewer, and is included in the price.

To use the viewer without the Barlow lens, you need a telescope with a large amount of back focus, so it may not be usable with Newtonians and some refractors. However, SCT's may work for this application. The Barlow extends the focal plane to enable you to focus without the need to modify your telescope, which is a great advantage, and makes it usable on all of your telescopes.

If you think deep sky objects are not suitable for the viewer you will be surprised, since the benefit from using both eyes will be better perception and comfort during viewing. Though the object is not as bright, the effect is pleasing. The effect for lunar and planetary viewing is even more important since subtle detail is more clearly perceived and the observer is more relaxed.

This causes less fatigue during those long sessions when we are trying to make drawings and write notes on our observation forms. Another advantage is that a second Barlow lens, in addition to the one supplied by the manufacturer, can be added to again double the magnification. That yields a 4x increase in magnification, which is useful on the Moon and planets. I have used this quite effectively with two 40mm eyepieces.

What are the drawbacks? There are huge differences in quality and design, so beware. Attend some stargazes and look through binoviewers. Be sure to note the brand because they are not all alike. The cost of the viewer is high and you need two eyepieces for viewing. You can



order standard focal lengths, but they must be matching sets of eyepieces, which means the same brand and optical design. Before you buy, test your eyes for defects using your existing telescope. These will show up when you are using an exit pupil of less than 1.5 mm. (To calculate the exit pupil size, divide the aperture of your telescope in millimeters by the magnification.

So, if you are using a 6-inch telescope [152mm] and 102x magnification, you have a 1.5mm exit pupil.) Test with one eye and then the other, looking for anything in the view, like objects in the way of the image to your retina. If you do see a cataract or some object like a streamer or string, you may not want to buy a viewer. I have a cataract in my right eye that is about 1mm in size and irregular in shape, but I still enjoy the viewer since I can look “around” the cataract and I am willing to live with it.

I recommend the highest quality viewers. While some of the lower cost viewers have been usable by some people, a poorly designed and built viewer will lead only to frustration and you just won't use it. Consider using the straight-through type of viewer for Newtonian telescopes rather than the elbow type. The elbow type may be more suitable for refractors and SCT's.

The binocular viewer could become another useful tool in your ever expanding box for your eyepieces.



## **New Books Received**

### ***Telescopic Martian Dust Storms: A Narrative and Catalogue***

Richard J. McKim; Memoirs of the British Astronomical Association. Volume 44 (1999) British Astronomical Association, Burlington House, Piccadilly, London W1V 9AG. 165 pages, illustrated. \$32 U.S. paperbound, incl. airmail postage and packaging.

#### **Reviewed by Donald C. Parker, ALPO Mars Section**

Martian dust storms are largely unpredictable and violent events that have captured the imaginations of both astronomers and lay people thanks to science fiction books and (unfortunately!) movies. Now much of the mystery of these storms has been stripped away due to the work of Dr. Richard McKim, who has compiled what is by far the most thorough history of these occurrences. This book, which started as a simple list of dust storms observed during the first 100 years (1982-1993) of the British Astronomical Association (BAA), has expanded into a continuous account of Martian dust activity for every apparition since the telescopic record began. But this book goes far beyond merely listing storms — it details their origins and progressions, their seasonal and areographical occurrences, and related changes that they have wrought upon the Martian surface. Dr. McKim is no stranger to Mars: an active observer, he has been the BAA's Mars Section director since 1980 and has exchanged observations and data with the ALPO and similar organizations throughout the world. This experience has permitted critical examination of the data with culling out of erroneous observations. His treatise is based upon not only the BAA archives but on contributions from more than a score of astronomical societies, including the ALPO, and over 500 individual professional and amateur observers. Much of the information is from previously unpublished work that often required the author's transla-

tion. While the book deals primarily with telescopic observations, McKim also discusses data gleaned from spacecraft and the HST.

After an introduction detailing his methods of analysis and defining various terms, McKim discusses Mars observations from 1659 to 1890. While only eight dust storms have been verified during this period, the narrative provides an interesting insight into the work of early Mars astronomers. It is noteworthy that these observers were primarily interested in mapping the planet and either ignored or misunderstood atmospheric phenomena.

The main body of the book, covering 91 pages, is a detailed narrative of dust storms detected between 1890 and 1993. Each apparition is covered in detail with observers listed and detailed drawings and photographs presented. The reproduction quality of the illustrations is excellent, and the captions are lucid. Much of the data is, of course, based on drawings, but it is interesting to note that even when the photographic record was ample, drawings were still most valuable. It was especially gratifying to see drawings made by such luminaries as E. C. Slipher and G. P. Kuiper, both of whom has access to large professional photographic telescopes. A number of these drawings had never been published previously. McKim points out that visual observations are often better for defining the boundaries and details of a storm, since photographs [and CCDs?] often exaggerate the sizes of the dust clouds. This is a reminder for ALPO astronomers that visual observations are still the backbone of our work, even in the "CCD Age!"

Part III of Dr. McKim's book includes a location chart of regional and planet-encircling storms and a catalogue of the 174 dust events observed from 1704 through 1993. The dates, durations, Areocentric longitudes (Ls) and

locations of onsets, and classifications are presented. McKim uses and explains Leonard Martin's classification, organizing the storms into four categories: local, regional, encircling, and global. It is noteworthy that there has been only one truly global dust storm, occurring in 1971, and only eight encircling storms, five of which occurred between 1973 and 1982. This is not due to inferior coverage during earlier apparitions: Dr. McKim presents ample proof that Mars was well observed during the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, and encircling dust storms would not have been missed!

Part IV presents statistical analyses of seasonal trends and areographic preferences for dust events. Numerous clear and well-defined histograms and graphs are included. It is gratifying that the seasonal peaks for dust storms (Ls=260° and Ls=320°) agree with those of Beish and Parker's ALPO Mars Section analysis of Martian meteorology from 1969 to 1984. McKim, however has found that these peaks have shifted over the past 150 years, although they remain in the southern spring and summer. The "preferred" sites of dust activity have also apparently changed over the past century. These findings suggest changes in Martian climate on a timescale of decades.

I found that one of the most interesting and useful things about Dr. McKim's book is his analysis of the variability of Mars' albedo features in relation to dust storms. These changes are discussed in great detail in the individual apparition reports and are beautifully presented in Part IV with copious drawings and photographs. What were previously thought to be seasonal changes are shown to be more likely related to dust events. An example is the "seasonal" change in the size and shape of Syrtis Major that is still considered to be a classical example of seasonal variation, although the feature has retained its form for two decades! Secular, or long-term, changes are also discussed in detail. An example is the dramatic fading of Trivium-Cerberus during the past

decade, a phenomenon that has generated considerable interest among professional HST astronomers.

The Appendices provide thorough lists of contributors, books and journals, detailed Mars reference maps and even a portrait gallery of fifty Mars observers.

The only fault I can find in the book is the frequent references to dust storms as "yellow clouds/hazes." The ALPO Mars Coordinators have attempted to avoid the term "yellow," since it is too subjective and often misinterpreted by novice observers. Furthermore, most clouds on Mars appear bright in yellow light! Dr. McKim does, however, properly define the properties of dust clouds in his introduction: They are always bright in red light, persist throughout the Martian day, and exhibit expansion and movement, obscuring underlying albedo features. He also lists diminution of limb brightening and orographic clouds, and correctly states that several criteria should be used in identifying a true dust storm.

*Telescopic Martian Dust Storms* is a superb book and would be a welcome addition to the library of anyone interested in Mars, professional or amateur, active observer or "arm-chair" astronomer. It is far more than a book about dust storms; it details much of the history of Mars observation and gives perspective to the enigmatic changes we have seen on that dynamic world.

*Comments and photos of Mars by Frank Melillo with additional comments by Don Parker regarding the current Martian dust storm appear in the ALPO Pages earlier in this issue of the Strolling Astronomer*

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- **Monograph Number 2. *Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June***

## ALPO Resources (continued)

- 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.
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  - **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.
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  - **Mars (Troiani):** (1) *Martian Chronicle*; published approximately monthly during each apparition; send 8 to 10 SASEs; (2) *Observing Forms*; send SASE to obtain one form for you to copy; otherwise send \$3.60 to obtain 25 copies (make checks payable to "J.D. Beish.").

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  - **Minor Planets (Derald D. Eye):** *The Minor Planets Bulletin*, published quarterly \$9 per year in the U.S., Mexico and Canada, \$13 per year elsewhere (air mail only). Send check or money order payable to Mr. Nye to 10385 East Observatory Dr., Corona de Tucson, AZ 85641-2309.
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