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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 43, Number 3, Summer 2001

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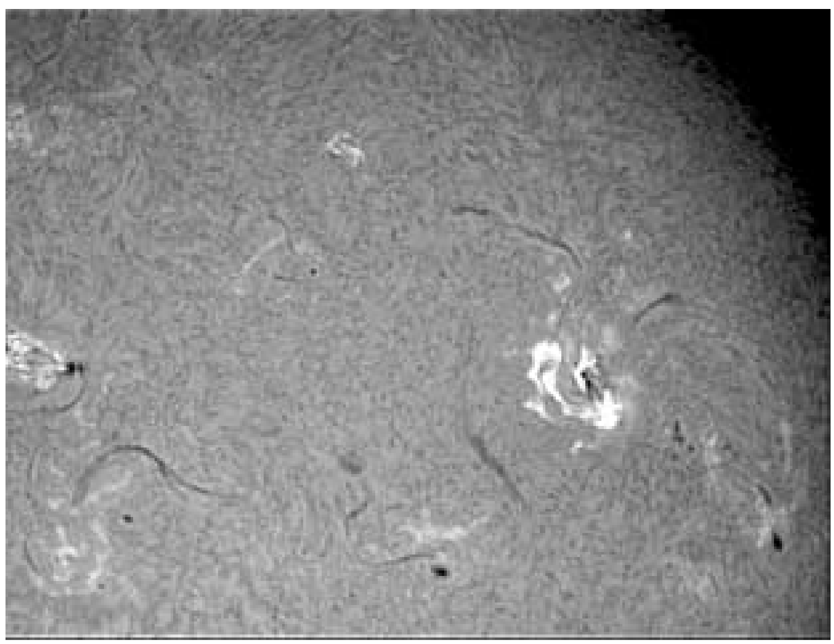
Inside . . .

Our VERY active Sun



It's been a most rewarding summer for solar observers, whether they use h-alpha or solar screen or aluminized mylar filters.

This month's cover features a dramatic astrophoto of a powerful (X-class) solar flare, taken 25 October, 2001, 15:46 UT by Frank Schiralli, Jr. of Northport, NY. Contact him at astroimager11768@yahoo.com

Equipment: Coronado 40mm SolarMax filter, 94mm Brandon, and Starlight Xpress MX916 camera.

Also ..a follow-up report on hook-like shadows on the floor of the lunar crater Plato, reports on Venus, the Remote Planets, and an index to Volume 42 of the Strolling Astronomer -- plus ALPO observing section reports and much, much more.

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

Volume 43, No. 3, Summer 2001
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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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Point of View

By Ken Poshedly, Acting Editor & Publisher Journal of the Assn. of Lunar & Planetary Observers

Even though I may be criticized for saying so, I think I would be remiss in not recognizing that the terrorist attacks of Sept. 11 touched nearly every facet of our lives, including those of us in the Assn. of Lunar & Planetary Observers.

Whether you live in California or New York, or even overseas, and even if you knew no one at the World Trade Center, the Pentagon or on the planes that carried the hundreds of people to their deaths, the ripple effects of the terrorist attacks continue to trickle down and affect just about all we do. Today, all of us are much more wary about the envelopes we get in the mail, the people we see in lines next to us in public places, and we may even be a little more careful about our jaunts to dark sky sites for sky observing and ALPO sessions.

While I myself knew no one firsthand who was lost or injured, a fellow member of the Atlanta Astronomy Club here lost his nephew, Jeremy Glick, who was one of those brave persons who used his cellphone to let the world know his plane had been hijacked and that the passengers were at least going to try to take it back. We'll never know for sure, but maybe it was the actions of Jeremy and his fellow passengers that kept the plane from reaching Washington, DC. Instead, it crashed outside Pittsburgh, Pennsylvania.

And our good members who live in or anywhere near New York City continue to suffer the direct pain of that tragic day as the site of the former office building complex is cleared, bodies are found, and even smoke and odors from the ongoing fires continue to waft far away.

One wonders how can they even think of hoisting a telescope out anymore. But to some, our interests and our celestial activities have therapeutic value. Some folks use astronomy partly as a means to clear their minds of sad and tragic events. They don't get the satisfaction that once was. But they know that it will eventually return. Right now, astronomy may be the only thing that keeps them from falling apart themselves.

We, the ALPO, offer our deepest sympathies and condolences to those of you who lost loved ones in the Sept. 11 tragedies.

The ALPO Pages:
Member, section and activity news

Letters

Reference follow-up needed

. . . on page 29 ("Observing for Lunar Flahes"), there is a reference to an article by Stuart Leon as being in the JALPO Vo. 10, Nos. 5-6, pp. 42-43, 1956. I cannot find the article in my copy. Could you please have the author research this and publish a correction in the next issue? In the mean time, please let me know what is the correct reference. BTW. I now have a near complete run of the JALPO back to the beginning. I am missing only a few issues.

-- Bob Garfinkle, ragarf@earthlink.net

Equation clarification

In his very valuable article on the extensions of the cusps of Venus (JALPO 42(2):58-66, April, 2000), Mr. Walter Haas calculates theoretical extensions of the cusps using the equation,

$$\cos(p/2) = -\sin l \csc i \qquad \text{(his equation 3)}$$

He assumes that this equation is inexact because it is an approximation of his unsolvable equation 1. He then proposes (p. 63, list item 4) that one reason the theoretical cusp extensions do not correspond precisely to observations is that, due to the approximate nature of equation 3, the calculations are merely approximations.

In fact, Haas's equation 3 is precise. I have developed a four-page proof of this that I am happy to send to anyone who sends a self-addressed, stamped envelope to me at 3405 Woodstone Place, Augusta, GA 30909. The proof is of too narrow interest to merit publication in JALPO.

The thrust of Haas's article is unaffected by this proof. The only one of his conclusions that should be changed is his supposition that more accurate theoretical calculations might correspond more closely to the observed values.

Roger Venable, rjvmd@knology.net

Look for details of the ALPO Board meeting in your next *Strolling Astronomer*

Thinking of contributing?

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

- All submissions, including "Letters to the Editor", should be accompanied by a cover letter stating that the material is being submitted for publication. Please give your telephone number, fax number and e-mail address if you have them. A single copy of a submission is usually sufficient, although we recommend strongly that the author(s) retain their own copy.
- In terms of content, we deal with the objects in the Solar System; the Sun, Moon, major and minor planets, comets, and meteors. Our emphasis is on observations and observing techniques rather than theory or cosmology. Ordinarily, submissions should not exceed a total of 10-12 printed pages including illustrations; allow about 1,000 words per printed page.
- The ALPO publishes in the English language only. All submissions should be in clear, grammatical English.

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

Solar Section

By Rik Hill

THE LEONIDS ARE COMING! In only a couple weeks we will all be waiting breathless for the possibility of a meteor storm. The latest predictions for this activity will be posted at:

http://www.lpl.arizona.edu/~rhill/alpo/meteorstuff/outlook.html

The Lunar Meteoritic Impact Search, a sub-Section of the ALPO Lunar Section now in it's second year, is mounting a big effort to observe some Leonid impacts on the moon. Get the details at:

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

Jupiter observations continue to pour in as the grand planet approaches opposition. Incredible work is now routinely being done by amatuer astronomers at or near the resolution limits of their instruments. We invite you to take a look at some of the results at:

http://www.lpl.arizona.edu/~rhill/alpo/jupstuff/recobs.html

Though Mars is starting to get small, still there are a number of amateurs that are still imaging the planet. Their work can be enjoyed at:

http://www.lpl.arizona.edu/~rhill/alpo/marstuff/recobs.html

The Remote Planets Section, Recent Observations page has had a lot of upgrading and additions. Here you will find some spectacular work done with modest apertures in various wavelengths and spectroscopy!

http://www.lpl.arizona.edu/~rhill/alpo/remplan.html

There's still a lot of solar activity to be had and you can see some of it on the Solar Section pages at:

http://www.lpl.arizona.edu/~rhill/alpo/solar.html

Go to the Recent ALPOSS Observations link for up to date observations by amateur astronomers from around the world.

Mercury Section

By Frank Melillo

(The following are excerpts from his complete report which can be found on the ALPO website.)

COORDINATOR’S CORNER:

The ALCON/ALPO convention took place in Frederick, MD, on July 25 - 28, 2001, and it was very well-attended. It was there that I presented my talk on “Scientific Interests of the Planet Mercury”. (Lots of compliments afterwards on my images of Mercury.)

It wasn’t until after I left (early, for family reasons) that I learned that I had won the ALPO “Walter Haas” award in recognition of many years of excellent planetary observations.

I met many ALPO member at the convention. It was such a thrill that I have corresponded with them for many years and finally I met them in person. In fact, I heard that it was the first time that the ALPO convention papers covered Mercury through Pluto. Both planets are rarely mentioned in many talks. As you can see, Mars, Jupiter and Saturn are very well-observed. Most importantly, the remote planets and even Mercury and Venus now need more attention.

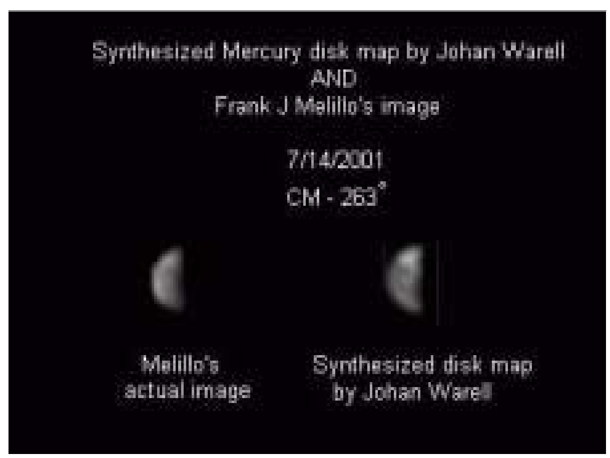
MERCURY NEWS:

As stated in my last newsletter, the morning apparition (June 16 to August 6) was a so-so opportunity to observe Mercury. But I did take some excellent images of Mercury. The best so far! Even Mario Frassati of Italy, did some excellent sketches of Mercury. In fact, Mario and I were the only ones to contribute during that apparition.

On July 14, 15 and 21, I took images of Mercury in full daylight about 70 degrees above the horizon! The observations were done when the sky was crystal blue.

Thanks to Venus! I used it as a guide to find Mercury. After I set up Venus’ coordinates, it took me 30 seconds to find Mercury in a low-power field. Believe me, it wasn’t too difficult at all! Mercury’s phase was clear as a bell. I replaced the eyepiece with a CCD camera and took some excellent shots.

Johan Warell of Uppsula University in Sweden made some excellent researches on Mercury for the past 5 years. He even wrote a paper on “Properties of the Herman regolith: Global regolith albedo variation at 200km scale from multicolor CCD imaging”. I tell you that this is one excellent paper! At one point, he made a synthesized map of Mercury on July 14. With his albedo map on that date, Mercury should appear like this:



Synthesized Mercury disk map (right) by John Warell with comparison of ccd image (left) by Frank Melillo. Taken 14 July, 2000, CM = 263°

Believe it or not, I had imaged Mercury at the very same day! What I did was I to degrade the map’s resolution, making it equivilant in scale to an image as seen in an 8-inch telescope. Surprisingly, both images -- his and mine -- look identical to each other!

Venus Section

By Julius Benton

ALPO Venus Section observers attempt to follow Venus on every possible clear night throughout an apparition of the planet, which runs from conjunction to subsequent conjunction with the Sun.

The minimum recommended aperture for useful observations of Venus is about 15.2 cm. (6.0 in.) for reflectors or 7.5 cm. (3.0 in.) for refractors. Low-transmission color filters increase contrast and definition while limiting the effects of irradiation. For example, Wratten blue (W38A) and violet (W47) filters are useful for low contrast detail, mainly because of the yellowish atmospheric cloud layer. Variable-density polarizing filters are especially useful in reducing glare and improving the visibility of faint markings.

Since Venus is an inferior planet (with an interior orbit to that of the Earth), it exhibits phases like the Moon. Also, since Venus is comparatively near the Sun, it is characteristically very bright. The high albedo produces an excessive amount of glare, making it difficult for observers to see elusive, low-contrast atmospheric markings on Venus. Controversy persists as to the true nature of these dusky amorphous or somewhat streaky atmospheric features. It is not at all unusual for two observers, working on the same date with comparable instrumentation, to see striking dissimilar atmospheric phenomena on the planet.

Venus attains a maximum angular distance of about 47º from the Sun, so it is usually observed near sunrise or sunset. When Venus is seen against a dark sky, the effects arising from its excessive brilliance are pronounced. At eastern (evening) apparitions, Venus is typically low in the western sky where atmospheric refraction and prismatic dispersion can ruin image quality, and many observers try to view Venus only when it has an altitude of 20º or more above the horizon. At times of western (morning) apparitions, observers can wait until Venus gains altitude and the background sky brightens considerably. Also at such times, Venus can readily be followed into daylight when most of the prevailing glare associated with the planet is reduced.

The ALPO Venus Section international observing network is currently comprised of about 20-25 observers, and there is active professional-amateur collaboration. Widely-spaced observations are of limited value, and the ALPO Venus Section stresses systematic, as well as simultaneous, observations to improve the objectivity of reports of elusive atmospheric features on Venus. Drawing blanks and report forms are furnished by the ALPO Venus Section to record data, and studies of Venus are organized into the following main programs:

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

Individuals interested in participating in the ALPO Venus programs should contact:

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Lunar Section: Selected Areas Program

By Julius Benton

The ALPO Lunar Selected Areas Program stresses systematic visual monitoring of variable phenomena at the surface of the Moon with specific emphasis on suspected long-term cyclical or “seasonal” albedo or morphological fluctuations in *"selected areas"* over many lunations. This is one of many areas of lunar research in which the skillful and imaginative amateur astronomer can find worthwhile observational opportunities.

Special talents for drawing lunar features, although definitely helpful, are not necessary for this program. The most fundamental and essential prerequisite for participation in the Selected Areas Program is the willingness to follow the Moon and the chosen feature(s) for many consecutive lunations, year after year. A good 10.2cm. (4.0in.) refractor or 20.0cm. (8.0 in.) reflector will deliver sufficient resolution of lunar detail for full participation in nearly all aspects of the program.

Initially, the observing program involves monitoring selected lunar features to establish a baseline of the *normal*, yet often complex, changes in appearance and albedo that they undergo from lunar sunrise to sunset over many lunations. This “control” serves as a reference for observers so they might recognize *anomalous* variations in morphology, tone (albedo), or color, that are attributable to changing solar angle (phase angle) or libration, and which clearly *do not* repeat systematically from lunation to lunation. Anomalous phenomena that the Selected Areas Program looks for are:

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

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

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

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

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

6. *Eclipse-Induced Phenomen*a. These are features that exhibit anomalous characteristics (categories 1 through 4 above) during and after an eclipse, compared with previous eclipses when the same areas were monitored.

The lunar features that are currently designated as the *official* lunar formations that are being monitored as part of the Selected Areas Program (SAP) are *Alphonsus*, *Aristarchus-Herodotus*, *Atlas*, *Copernicus*, *Plato*, *Theophilus*, and *Tycho*. All of these areas were chosen because they are relatively easy to find, convenient to observe, and have historically shown numerous instances of suspected anomalies. Complete outline charts and observing forms are available from the ALPO Lunar Section for each of the features noted.

Thus, observations of the Moon that are specific to the Lunar Selected Areas Program may be summarized as:

- Visual photometry of specific lunar features, defining their normal albedo profiles throughout a lunation as a function of changing solar illumination.
- Visual photometry of specific lunar features, monitoring variations from their normal albedo that are not simply a result of changing solar illumination.
- Drawings of specific lunar features throughout a lunation and from lunation-to-lunation in conjunction with visual photometry.
- Routine photography, CCD imaging, photoelectric photometry, and videography of specific lunar features to supplement visual photometry programs throughout a lunation and from lunation-to-lunation.
- Comparative analysis of lunar features and albedo profiles.

It should be pointed out that the Selected Areas Program now includes the Bright and Banded Craters Program and the Dark-Haloed Craters Program. Further information on these programs is available upon request. Complete details on our observing programs can be found in the *ALPO Lunar Selected Areas Handbook*. Individuals interested in participating in the ALPO Lunar Selected Areas Program should contact:

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Lunar Section: Lunar Meteoritic Impact Search Report

By Brian Cudnik

Regular monitoring of the Moon continued during 2001, but focused more on the the flux of meteoroids received by the waxing crescent Moon during a monthly campaign carried out by two individuals. Several other individuals contributed observations of possible impact candidates, but none of them has been confirmed to date. Our focus shifts toward the Leonid event in November, which could possibly be the last significant opportunity to observe lunar meteorites for quite some time. There is always opportunity to watch for lunar meteorites, but the probability of observing and confirming them is greatest during the Leonids due to the combination of high meteoroid flux and velocity.

Dr. Anthony Cook of Washington, D.C., in January began a systematic watch of the Moon for a period of one week each month. This "Earthshine watch" occured monthly during the period from three days after New Moon to two days after First Quarter. He was joined in the effort by Sam Falvo of Utica, New York, in May. Several candidate events were reported by these two, and two additional observers reported events as well. The vast majority of Dr. Cook's many observed "events" were actually cosmic ray signitures. His candidates which have the greatest likelihood of being genuine events appear below. However, it is important to stress that none of the events listed has been independently confirmed, so it is very possible that each of these is artificial as well.

Some of Tony Cook's best candidates:

- April 30th, 01:55:45UTC "I'd go for as a lunar impact on this night - this one was merged with background noise and about the size of Aristarchus."
- Apr 27, 00:43:25 UTC - "[I]t is difficult to be tell if this a 'cosmic ray or impact flash' for sure"
- Apr 27 01:12:02 UTC - "[I]t is difficult to tell if this a 'cosmic ray or impact flash' for sure?"
- 01:18:29, 27 Aug UTC - "Bright flash S of Timocharis. Size and brightness not too disimilar to nearby sunlit peaks on terminator.

Sam Falvo's candidate:

02:55:03, 28 Jun 28 UT - "a brief flash, much less than one-second duration. It was in the dark side to the left of partially illuminated Hipparchus. I estimate it to be quite near the crater Flammerion."

Other impact candidates were observed by IOTA member Dave English, of Oceanside, California, at 6:58:30 UT,30 May 30; and Capt. R. Patterson (ret) of Port St John, Florida, on 26 June 2001, 3:39 UT

Dr. Cook has come to an initial conclusion that during non-shower times, the rate of capture of genuine impact events on the Moon is about one per tens of hours of observing time. Further observations by him and other LMIS observers will help to improve this assertion and obtain a more refined value.

Meteors Section

By Robert Lunsford

The ALPO Meteors Section continues to provide current information on meteor activity through two sources: the Meteors Section Newsletter (published quarterly) provides a review of the meteor activity seen during the most recent quarter with articles and actual data from observers. It also provides an outlook for the next quarter. The Meteors Section website provides an in depth analysis of the upcoming week's meteor activity plus a general outlook for the current year.

The section coordinator is participating in an expedition to Arizona to observe and record the expected Leonid storm this November. The following month, he and the assistant coordinator will lead another expedition to the Mojave Desert to view the Geminid meteor shower. Reports on these expeditions will be available in the December 01 and the March 02 issues of the ALPO Meteors Section Newsletter.

Mars Section

By Daniel P. Joyce, Assistant Coordinator, Mars Section

Dust Subsiding???

The dust activity that has been the dominant phenomenon witnessed by hundreds of observers since the fourth week of June has at least shown signs of thinning out in recent weeks. It may yet be too early to draw the conclusion that by the end of October all albedo features will yet again attain their normal prominence. Even as some regions have slowly been unveiled, there appear to be possible new dust outbreaks as the favorable season has been reached. It is once again important to assert that the June outbreak was entirely uncharacteristic of the season. This demonstrates the alertness and discernment on the part of those who (mostly in Japan) did not allow preconceived notions to impair their perception of what they were seeing and of having the shrewdness to immediately report their findings.

In the not-too-distant-future, it is hoped, the Section will begin to acknowledge the fine work of the observing network that spans the globe. It was a particularly difficult time for our European friends, especially north of Italy, as often a 10 degree maximum altitude for Mars had to suffice. We are indebted to those who provided imagery despite the conditions! Probably not enough could ever be said about the specular reflection sightings made by a party of observers who not only saw them, but were the beneficiaries of a prediction to the effect that the phenomenon would in fact occur. Research into past observations, even those scant (and arguably obscure) paid huge dividends. The observations of nearly a half-century ago were painstakingly correlated with modern space probe accumulated data when it was not obvious that such a connection was there for the making.

It is also to be noted that a German periodical "Sterne Und Weltraum" (Stars and World?) has placed Mars prominently on its July cover and provided a substantial accompanying pull-out chart which they attribute in some measure to the work of our Section coordinator Dan Troiani (Mars Global Surveyor helped a little, too!).

But don't quit just yet; the apparition is far from over and Mars is still ten arc-seconds. Furthermore, it is just past perihelion and therefore able to maintain a fair pace with the faster earth, which therefore cannot pull away at its customary rate at this date past opposition. So keep looking!

Jupiter Section

By Richard Schmude

The 2000-2001 Jupiter report is almost complete. The magnitudes and color indexes of Jupiter were measured by R. Schmude and H. Lesser in late 2000, and the resulting magnitudes were close to the expected value. Dr. Schmude also measured the brightness of Jupiter over a 5-hour period on Dec. 8 and found that Jupiter became about 2 - 3% dimmer as the Great Red Spot crossed the central meridian. In mid-2001, Jupiter became visible in the morning sky. The biggest changes are that the North Equatorial Belt became dimmer and that the Equatorial Zone became more yellow.

Saturn Section

By Julius Benton

Almost any optical assistance will show Saturn's spectacular ring system, and the major disc features are revealed with a 7.5cm. (3.0 in.) refractor, including perhaps a major belt and a zone or two near the equator of the planet. Cassini's Division should also be visible in the rings with such an instrument. With a 10.2cm. (4.0 in.) refractor or a 15.2cm. (6.0 in.) reflector, the observer will discover that he has found about the minimum aperture suitable for routine and beginning detailed studies of Saturn. Of course, when seeing conditions allow, the larger the aperture, the greater will be the image scale and the better the resolution and image brightness.

A novice should spend at least some time in experimental work with the telescope he intends to use for routine views of Saturn. One should always try to establish the best combination of magnification, filters, and image size, brightness, and contrast. These topics, and many others, are discussed in considerable detail in *The Saturn Handbook*. After gaining some practical experience in observing Saturn, individuals are encouraged to become familiar with more advanced methods and techniques for observing.

Like Jupiter, Saturn displays in an appropriate telescope a series of bright zones and darker belts that run roughly parallel to the equator. Much of the fundamental nomenclature assigned to the specific zones and belts of Jupiter applies to Saturn. *The Saturn Handbook* gives more detail on the specialized uses of all of the terminology and nomenclature for Saturn's global and ring features.

The ALPO Saturn Section international observing network is currently comprised of about 30-35 observers, and there is active professional-amateur collaboration. Studies of Saturn's globe, rings, and satellites are organized into the following main programs:

- Visual numerical relative intensity estimates of belts, zones, and ring components.
- Full-disc drawings and sectional sketches of global and ring phenomena (the Saturn Section furnishes templates with the correct global oblateness and ring geometry to facilitate making drawings).
- Central meridian (CM) transit timings of details in belts and zones on the globe of Saturn (utilized to determine or confirm rotation rates in various latitudes).
- Visual latitude estimates or filar micrometer measurements of belts and zones on the globe of Saturn.
- Colorimetry and absolute color estimates of globe and ring features.
- Observation of "intensity minima" in the rings (in addition to observations of Cassini's and Encke's divisions).
- Observational monitoring of the bicolored aspect of the rings of Saturn.
- Observations of stellar occultations by Saturn's rings.
- Specialized observations of Saturn during edgewise ring presentations in addition to routine studies.
- Visual observations and magnitude estimates, as well as photoelectric photometry, of the satellites of Saturn.
- Spectroscopy and photometry of Titan.
- Routine photography, CCD imaging, photoelectric photometry, and videography of Saturn and its ring system.
- Simultaneous observations of Saturn.

Individuals interested in participating in the ALPO Saturn programs should contact:

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E-Mail: jbenton55@home.com (image files and attachments)

Remote Planets Section

By Richard Schmude

About 10 poeple have submitted a variety of measurements of Uranus, Neptune and Pluto during the past 6 months. Doug West has measured the brightness of Uranus, Neptune and Pluto using a CCD camera along with a Johnson V-filter. Dr. Schmude has measured the brightness of Uranus and Neptune and the results indicate that Uranus continues to get slightly dimmer. Neptune's brightness is about the same as what it was last year. Frank Melillo has measured the relative brightness of Titania, Oberon and Umbriel. Umbriel was measured to be 1.02 magnitudes dimmer than Oberon. Antonio Cidadao in Portugal was able to measure the Titania occultation on Sept. 8, 2001. R. Schmude and F. Melillo also carried out measurements but did not observe an occultation.

ALPO Website News

By Rik Hill

Mercury is now leaving the evening sky but you can still enjoy it with the latest *Mercury Today*, now available at:

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

Frank Melillo, has also just posted his latest Mercury images and Mercury newsletter on the ALPO Mercury Section pages at:

http://www.lpl.arizona.edu/~rhill/alpo/merc.html

You cannot help but be impressed by his work with only an 8-inch aperture and why he is so deserving of the award he was given.

The Minor Planets Section's Magnitude Alert Project is active and making regular postings to:

http://www.lpl.arizona.edu/~rhill/alpo/minplan/alert2001.html

And the ALPO Meteors Section makes its regular announcements and alerts to observers at:

http://www.lpl.arizona.edu/~rhill/alpo/meteorstuff/outlook.html

Both of these pages keep ALPO observers up-to-date with the latest information in their respective studies.

The June solar eclipse has spawned a bunch of great images by ALPO observers. You can see some of these at:

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

with more to come! And while you're there browse the rebuilt Eclipse Section page at:

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

Mars is now at east quadrature. Though its diameter is only 11 arc sec. it is still very observable. The numbers of observations submitted to the ALPO exceeds that of the last apparitions and has caused a reworking of the Mars Section observations page at:

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

Since the reworking, this page loads more rapidly and the user has quicker access to images posted.

Thanks to the generosity of Sylvain Rondi (France) there's a new look to Solar Section webpage. He has given us permission to use one of his solar prominence animations on our page and it really does look good:

http://www.lpl.arizona.edu/~rhill/alpo/solar.html

The Sun is still extremely active, and you can keep up with the activity at the newly rebuilt Solar Section observations page at:

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

Thanks to the work and generosity of Patrick McIntosh (*HelioSynoptics*) we also have graphic analysis of recent activity at the top of the ALPO solar webpage.

For a more comprehensive summary of ALPO activities, subscribe to our quarterly journal the *Strolling Astronomer - Journal of the ALPO* (JALPO). This is now available in digital format (DJALPO) at a reduced rate with faster delivery. See our website for details.

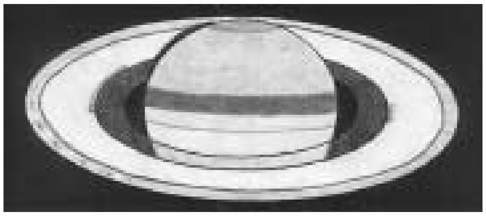
Other Contributions

These contributions are presented here to demonstrate what others are doing and hopefully to inspire others to do the same. These reports and images have not undergone ALPO peer review for scientific study. All ALPO members are invited to send their contributions directly to the ALPO section coordinator for the subject at hand. Also, due to the highly subjective nature of color sketches and drawings, only black & white drawings can be presented. Color astro-images which more objectively represent the true nature of the subject will be presented here.

Saturn

An observing report and sketch on Saturn from Eric Jamison <ericj@metro2000.net> of Pepperell, Massachussetts, posted on the *Shallow-Sky* listserv:

October 5, 2001, 8:25 - 9:05 UT, seeing 7 - 8, transparency 2. Astro-Physics 5.1" f/8.35 EDF refractor homemade Dobsonian-style mount. Magnification 264 - 308x with AP/Baader/Zeiss binoviewer.

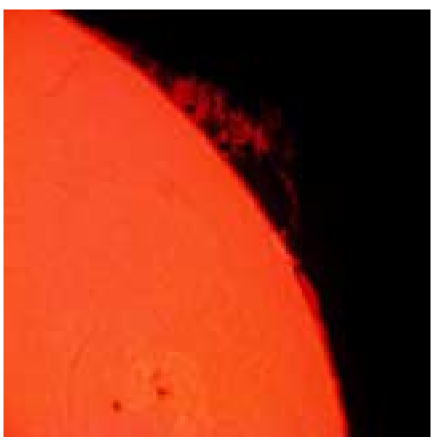


The shadow of the globe was visible on the rings, giving the planet a 3-dimensional look to it, but not as pronounced as it had been in early September. In the Equatorial Zone (EZ), the Equatorial Band (EB) was visible. Shading was noted on both the preceding and following ansae of the B-Ring. The C or Crepe Ring prominent, and the EZ north (EZn) was faintly visible through the C Ring. A-Ring appeared darker than the B-Ring.

The left (or preceding) ansa of the A-Ring showed some variation in tone, with lighter and darker areas visible. On the right (or following) ansa, the lighter areas were not visible and the darker areas were less pronounced. These darker areas were somewhat similar to an earlier observation I had of Saturn in September 1998, but smaller. Five satellites were visible near Saturn, including Tethys, Dione, Rhea, Titan, and Iapetus.

Sun

From Ginger Mayfield of Divide, Colorado <chikadee@earthlink.net>, posted on the *SolNet* listserv:



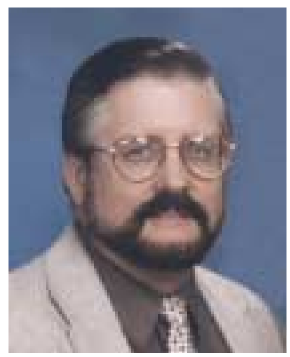
"The weekend at the Great Plains Star Party (16 Oct.) I had a chance to do some solar viewing through a new friend's 90mm refractor and Coronado H-alpha filter. It was one of those beautiful blue sky days that comes after cloudiness and we were all up for some sunshine and solar viewing. After viewing with a single eyepiece for awhile we decided to try my TV binoviewer and the views were really amazing! There were several large prominences and the surface detail almost seemed three dimensional with the binoviewer. We were lucky to have great weather all afternoon and many folks came by for a look and later brought back friends for more viewing. I brought over my digital camera and 35mm Panoptic and took some pictures, just to see if I could get anything decent. I've only had a very few minutes even looking through an H-alpha filter set up and no experience with imaging through one. I was very surprised when I got home and put them on a regular monitor to see that they turned out pretty good. For me, that afternoon of solar viewing (and a little bit of imaging) was one of the big highlights of the star party. And it was a lot of fun to do a collaboration with my friend with the solar equipment and my binoviewer for some awesome viewing. Now all I need is a solar set up like that! Here are the details for those who would like to know:

Scope - 90mm TMB refractor with a 90mm Coronado H-alpha filter
Camera -- Olympus C-2100 digital attached to a 35 Panoptic with a TV adapter, zoomed all the way in (10x).
Processed with Paint Shop Pro 7

http://home.earthlink.net/~chikadee/prom1011011.jpg
http://home.earthlink.net/~chikadee/prom1013013.jpg
http://home.earthlink.net/~chikadee/prom1013015.jpg

About the Authors

Solar Activity Report



The first observation by *Richard (Rik) Hill* (solar activity report) 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; he is a member of the board of directors of the ALPO. Rik worked on the Burrell Schmidt telescope (Kitt Peak) for 12 years and is currently with the Planetary Occultations Group and the Catalina Sky Survey (looking for potential Earth impactors) at the Lunar & Planetary Lab, Arizona 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.

ALPO Observations of Venus (1998)

Dr. Julius L. Benton, Jr. (Venus apparition report) is a native of Albany, Georgia, and joined the ALPO in 1967. He was appointed coordinator of the ALPO Lunar Section in 1970, heading up the Selected Areas Program, and in 1971, he assumed additional duties as coordinator of the Venus and Saturn Sections. He still holds all three posts today, after nearly three decades of successful leadership and administration of ALPO observing programs. In 1994, Julius was elected to the board of directors of the ALPO, and he has served as distribution editor for the *Journal of the ALPO* since 1996. In 1998 he became Associate Director of the organization. He is currently chairman of the ALPO board of directors. In addition to his professional research that has appeared in various technical journals, Julius has written extensively on the subjects of lunar and planetary astronomy for over 25 years. He can be reached at e-mail address: jlbaina@msn.com

Hook-Like Shadow on Plato's Floor

Co-authored by Giancarlo Favero (Osservatorio Guido Ruggieri, Padova, Italy), Raffaello Lena (GLR, Geologic Lunar Researches, Italy), Fabio Lottero (GLR, Geologic Lunar Researches, Italy), and Marco Fiaschi (Osservatorio Giuseppe Colombo, Padova, Italy).

Raffaello Lena founded the Geologic Lunar Research (GLR) group (http://digilander.iol.it/gibbidomine) and has published lunar articles in the *JALPO*, *Selenology* and Italian magazines. His primary interest is the study of lunar domes and their classification. The GLR group has members from several nations that participate in various lunar observing projects (domes, TLP, lunar flashes projects). Raffaello was recently named coordinator of the American Lunar Society's Lunar Impact Project. As such, he has done research of spurious flashes. He can be reached at e-mail address: gibbidomine@libero.it

Giancarlo Favero's (no photo supplied) interest in planetary astronomy was inspired about 1960 while he was in high school by Guido Ruggieri, a leading Italian planetary observer. With a home-made 7-inch reflector Giancarlo started observing Jupiter, Mars and the Moon. He received his degree in chemistry in 1969 and maintained his interest in astronomy, frequenting the Padua's Observatory and enjoing the friendship of his director, Prof. Leonida Rosino. Over the 1970s, Giancarlo directed the Jupiter Section of the Unione Astrofili Italiani (UAI) and published three papers in the *Journal of the Assn. of Lunar & Planetary Observers*. He was president of the UAI for six years, and for 30 years was professor of chemistry at the University of Padua. In 2000, he retired and subsequently joined the ALPO and returned to planetary astronomy, his youth's love.

No data supplied on Messrs. Lottero and Fiaschi

Observations of the Remote Planets

Richard Schmude Jr. is coordinator of both the Remote Planets Section and the Jupiter Section of the Assn. of Lunar & Planetary Observers, and is a member of the organization's board of directors. He first became interested in astronomy when he was six years old. At that time he noticed what seemed to be hundreds of stars in the sky -- this inspired him. He purchased his first telescope when he was 15 and showed a neighbor girl (Kathy) the Moon through this telescope. Since then, he has given over 200 astronomy presentations and telescope viewing sessions to the public. He is a member of the Association of Lunar and Planetary Observers (ALPO), the Royal Astronomical Society of Canada (RASC) and of the American Association of Variable Star Observers (AAVSO). His research interests include: measuring the brightness and color of the Moon and planets, planetary nebulae and the impact of acid rain on the environment. Richard lives in Barnesville, Georgia.

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Michael Mattei joined the ALPO in 1963 and has been observing the Moon and planets regularly ever since then. His professional career began at Harvard Observatory in 1967; since then, he has worked at the Wallace Astrophysical Observatory, Lincoln Labs, both of MIT, and now in the field of optics. He currently works as a senior optical technician at Schlumberger Silicon Division. Mike continues to build telescopes and optics at home, and do CCD and video imaging of the Moon and planets with a 6-inch Schupmann telescope which he built in 1983. He is currently working on a 10-inch Schupman.

Errata

Frank Melillo's photo was inadvertently placed next to the writeup of another author. This is Frank Melillo. Remember him. You may meet him and need to know him. We regret the error.

ALPO Feature: Solar Activity Report

Carrington Rotations 1911-1922 (1996-06-28.70 to 1997-05-22.10)

By Richard E. Hill
ALPO Solar Section Coordinator

Solar activity was low to nonexistent with only 69 numbered active regions on the Sun during this time. The average R(I) was 9.8 and R(A) was 9.7, very similar to the last report period (Carrington Rotations 1901-1910). All but one of the rotations had a number of days with a count of zero which meant that the variations in the averages were largely determined by the highs or bulk of the days with sizable numbers. The highest sunspot count for any rotation was 20.4 in CR1916 for R(I) and 19.4 in CR1921 for R(A) with the highest daily number for R(I) being 57 on 1996-11-25 (CR1916) and for R(A) 67 on 1997-05-21 (CR1922). Figure 1 is a graph of the rotational means for this reporting period. Since the official minimum occurred in May 1996, solar activity was very low. The increase is slight but note that the highest activity, whether tabulated by rotational or daily counts, was in the last half of this reporting period. There were a number of sunspot groups that exceeded 300 millionths of the disk in area (standard unit of measure for that parameter) in contrast to the last report where none exceeded that value. One even attained an area of 1000 millionths.

As one might expect, there were few observers and observations covering this period but still more than in the last report. This is not surprising since it was just past solar minimum. However it is again worth saying that observations are as important at low activity as at high. This is how solar minimum can be determined and understood.

Terms and abbreviations used in this report are defined in the newly revised Astronomical League book "Observe and Understand the Sun". Details on obtaining this can be found on the Solar Section webpage at:

http://www.lpl.arizona.ed/~rhill/solar.html

Sunspot classifications used in this report are in the McIntosh Classification System also explained in the new Astronomical League publication "A Three-Dimensional Sunspot Classification System". This is reprinted from an article in the *Strolling Astronomer* (*Journal of the Assn. of Lunar & Planetary Observers*) 33, Nos. 1-3, Jan., 1989, pp.10-13.

Times used in this report are Universal Time (U.T.). Directions are abbreviated (e.g. , N, E, SW etc.) and are celestial. Positional angular dimensions are heliographic while sunspot dimensions may be expressed in celestial arc dimensions (sec., min., etc). The term "group" refers to white-light collections of sunspots, while the term "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 keen-eyed observer to see a naked eye sunspot). Active Regions and sunspot groups are designated with the prefix "AR" and are designated by the Space Environment Center (SEC) of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado.

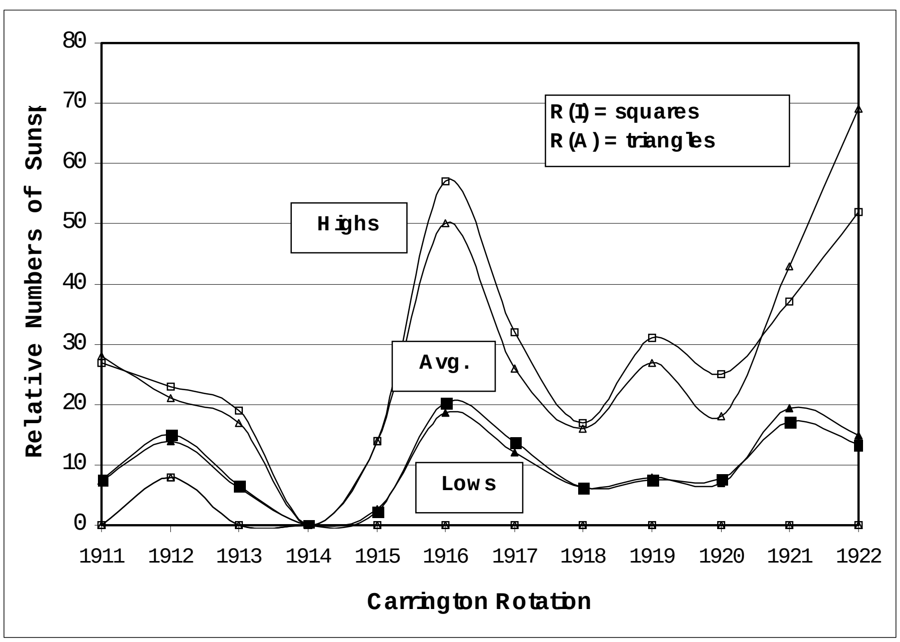

Figure 1: R(I) and R(A) for rotations 1911-1922 (1996-06-28.70 to 1997-05-22.10)

Table 1: Observers in Alphabetical Order

	Telescope				
Name	Aperture (cm)	F.L. (cm)	Type (cm)	Stop	Location

Brian Cudnik	11.3	90	rfl	n/a	Houston, TX
Michael DeTraglia	8	90	rfr	n/a	Wasilla, AK
Gordon Garcia	13	102	rfr	n/a	Hoffman Estates, IL
Richard Hill	12.5	125	s-c	n/a	Tucson, AZ
Paul Maxson	25	152	rfl	15	Phoenix, AZ
Anthony Portoni	40	163	rfl	23	Little Rock, AR
Jeffery Sandel	6	70	rfr	n/a	Cayce, SC
Fan-Lin Tao	25	375	rfr	n/a	Taipei, R.O.C.
Brad Timerson	11.4	127	rfl	n/a	Newark, NY

There were 9 observers for this reporting period.

Table 2: Solar Cycle Rotation 23, Rotation 1911

DATES: from 1996 06 28.70 to 1996 07 25.90					
	Mean	Max. & Date		Min. & Date	
R(I)	7.6	27	7/09	0	14 days
R(A)	7.4	28	7/09	0	14 days

This reporting period opens with activity at extremely low levels, the least since CR 1905, with only three Active Regions (ARs) designated in this rotation though the sunspot numbers themselves did not reflect this.

As this rotation began there was a decaying region on the Sun, AR7973. The beginning of its passage was covered in the last report. On 06/19 of the last report (and rotation) Maxson, at 1523UT, showed the region to consist of a single round spot with a symmetrical penumbra, class Hsx. It remained this way until it left the disk on 07/01 but was photographed by Garcia in two excellent white light images on 06/29 at 1404 and again at 1437UT. These showed a large spot surrounded by a filigree of faculae, part of it forming a ring around the spot. In an H-alpha image by Garcia the next day (1538UT) the region looked unremarkable.

Another region, AR7978, was notable in this rotation. It was first recorded by Maxson in a white light photograph on 07/07 (1632UT) just past the central meridian (CM). At that time it consisted of a spot with rudimentary penumbra, a collection of pores preceding and following. This observation was made at exactly the same time as the Space Environment Center produced one of their global active region maps that indicated there were no groups on the Sun!

The next day Timerson (1424UT), in a white light image, found significant development. The area was about 200 millionths of the disk and the class was Dai with a leader that was a few umbrae in penumbra with a trail of umbrae in rudimentary penumbrae leading back to the middle spot. The middle spot was a collection of six umbrae in penumbra and the follower spot was a collection of small umbrae aligned N-S (north-south) each with its own rudimentary penumbra. Sandel, in a white light drawing on 07/09 (1830-1903.2UT) showed the leader and the trail of umbrae to be merging into one penumbra. The middle spot was just two very small collections of small umbrae each in a rudimentary penumbra aligned N-S to each other. There were small pores scattered in the middle region as well. The follower or eastern most spot, was in three pieces each with several umbrae in rudimentary penumbra. The area by this time had doubled and it was generally classed as Eki. Again on 07/10 Sandel caught this group in a whole disk drawing (1915-35UT), as it neared the limb. The area was reduced to 350 millionths and the class was Eho. The leader was now more round with two large umbrae and the middle was just a collection of tiny umbrae and pores. The follower was a single spot of three umbrae in one penumbra.

As this group was at the limb it was clearly in decay. The area was now down to 220 millionths. In a Timerson white light photo of 07/11 (1528UT) and another Sandel whole disk drawing (2105-25UT) the leader was shown to be one large umbra in a symmetrical penumbra. The middle spot was reduced to two tiny umbrae and a collection of pores. The follower was two spots with penumbrae and appeared as one spot that may have been bisected by a light bridge. On the last day of visibility for the group Sandel, again in a whole disk drawing (2105-25UT), observed that the group was reduced to just a leader that consisted of a single spot on the limb followed by two tiny umbrae. As when it came onto the disk, there were a lot of attendant faculae.

Table 3: Solar Cycle 23, Rotation 1912

DATES: from 1996 07 25.90 to 1996 08 22.13					
	Mean	Max. & Date		Min. & Date	
R(I)	15	23	08/02-03	8	07/26
R(A)	14	21	08/02	8	3 days

Although all levels of activity at least doubled, still the overall level of activity was very low. There were six active regions designated during this time period, exactly double that of CR1911. This was the only rotation with more than zero for minimum sunspot numbers. Only two observers contributed to this rotation.

Only one region was worth a mention during this rotation, AR7981, the remnants of old AR7978 from the previous rotation. This region was not observed by the Solar Section as it came onto the disk on 07/28 with an area already over 100 millionths, but was first seen by Sandel in a whole disk white light drawing on 08/02 (1840-55UT). At this time the leader consisted of a large umbra in a symmetrical penumbra. The follower was two small spots oriented N-S with penumbrae and a scattering of tiny umbrae and pores. The area of this Eao group at this time had grown to 300 millionths. On 08/03 (1314UT) Garcia took a superb arc second quality photograph (Figure 2) that showed the leader to have a large umbra surrounded by a well developed, symmetrically radial penumbra. This was followed by tiny umbrae to the N and a larger umbra with rudimentary penumbra to the S. There was a N and S follower spot. The northern follower spot was a grouping of tiny umbrae with rudimentary penumbra while the southern follower had an umbra in an inverted 'V' shape open to the S with very rudimentary penumbra, where no filaments or fibrils seen at all. Sandel observed it, again in a whole disk white light drawing, about five hours later (1840-1905UT). He saw the leader to be relatively unchanged from the day before. The northern follower he saw as a spot with penumbra and the southern was a spot that had lost its penumbra with tiny umbrae and pores all around.

The next day, 08/04, was the last day of observation for this group by the Section members. Again, Garcia took a white light photo of the group (1343UT) that was a good photo but not the spectacular quality of the previous day. The leader was now more round but otherwise pretty much the same. It was followed by just pores to the N but the spot to the S was a dark round umbra. The follower spot was just a few pores. This group was obviously in decay with its area now decreased to 250 millionths and the class now Cso.

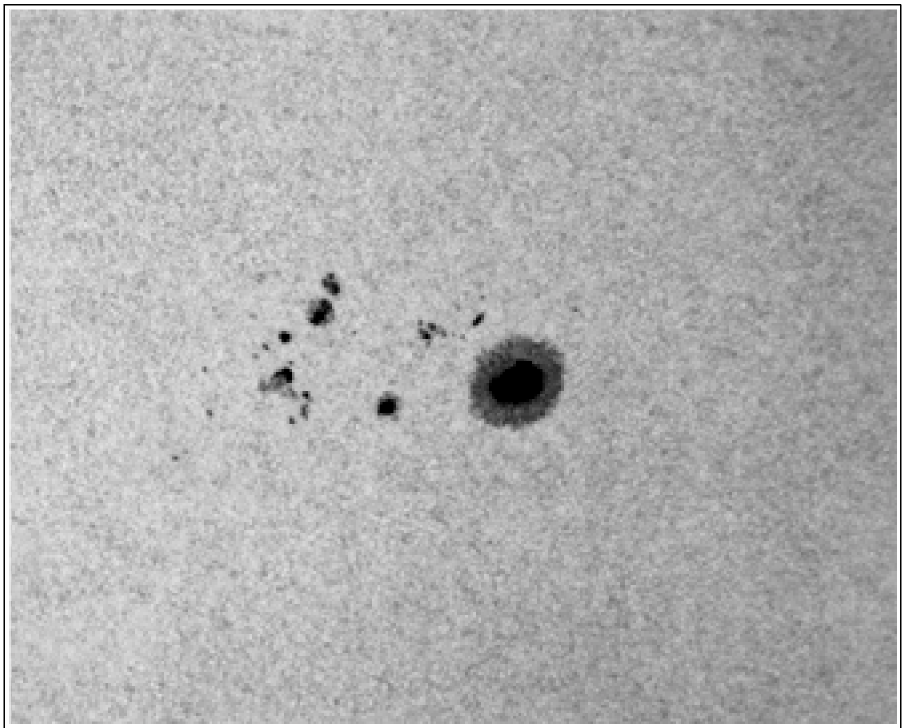

Figure 2: AR 7981 from rotation 1912 seen in arc second resolution, taken by Gordon Garcia at 1314 UT on 3 Aug. with an Astro-Physics 130 mm aperture Starfire EDT apochromat refractor using a Baader Herschel wedge prism with an ND8x and 25a (red) filter. North is at the bottom, west to the right. Note the penumbral detail (grains and fibrils) as well as the rudimentary penumbrae that lack these structures, detached bits of penumbrae, umbral spots and pores (not as dark as the umbral spots).

Table 4: Solar Cycle 23, Rotation 1913

DATES: from 1996 08 22.13 to 1996 09 18.39					
	Mean	Max. & Date		Min. & Date	
R(I)	6.5	19	08/31	0	12 days
R(A)	6.2	17	08/31	0	10 days

In CR1913 activity fell back to the extremely low levels seen in the first rotation of this report. Now, as then, there were only three regions designated by SEC during this rotation.

The best observed sunspot group of this rotation was AR7986, the remains of AR7981 (which itself was old AR7978). Its coming was preceded by a facular area on the limb as seen by Portoni in a whole disk white light drawing on 08/22 (1313UT). He again observed this area on 08/23 (1333UT) when it was measured to be about 12 arc seconds in N-S extent, with an umbra and what appeared to be a symmetrical, well developed penumbra surrounded by faculae.

On 08/24 (1451UT) Garcia produced another arc second quality photograph (Figure 3) that showed the whole group to be three umbrae in surrounding penumbra. Faculae formed a ring around the spot that now had and area of 100 millionths and a class of Hsx. In an H-alpha photo at 1659UT Garcia showed a huge filament to the N of the whole region that spanned about 120 degrees of an arc around the region. A bright plague corresponded to the faculae and extended to the E.

There were no submitted observations from 08/25-28. But on the 29th another Portoni whole disk white light drawing was noted to show that AR7986 had "darkening on N & S edges of the penumbra." The area had reduced to 50 millionths. The main spot was round with a symmetrical penumbra and several pores to the SE. A day later Portoni (1340UT) showed this situation to be unchanged but the pores were gone. The last day of observations for this region was 09/02. Again it was Portoni that made the observation with one of his drawings. The group was now near the limb and much reduced (40 millionths) and was just an umbra surrounded by a ring of faculae with more faculae following. This was the last that was seen of this region that had lasted for three rotations.

Table 5: Solar Cycle 23, Rotation 1914

DATES: from 1996 09 18.39 to 1996 10 15.67					
	Mean	Max. & Date		Min. & Date	
R(I)	0	0	--	0	--
R(A)	0	0	--	0	--

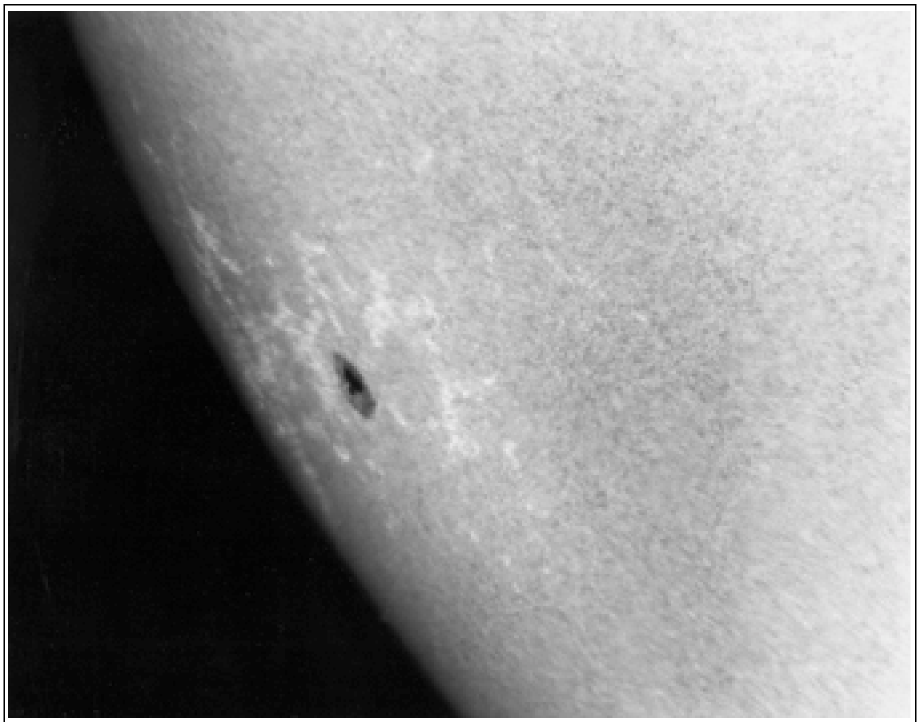

Figure 3: AR 7986 from rotation 1913 seen on the limb, taken by Gordon Garcia at 1451 UT on 24 Aug. with an Astro-Physics 130 mm aperture Starfire EDT apochromat refractor using a Baader Herschel wedge prism with an ND8x and 25a (red) filter. North is at the bottom, west to the right. Note the extensive faculae.

This rotation marked the low of this reporting period. There were, as the numbers show, no sunspots that lasted more than an hour or so. Only six observations total were submitted, all by DeTraglia, and all confirmed the numbers above.

This rotation marked a unique event in the near 20 year history of the Solar Section. This is the first time since CR1732 of a totally zero sunspot count. In fact, this is the lowest count that is possible. See the end of this report for further analysis.

Table 6: Solar Cycle, Rotation 1915

DATES: from 1996 10 15.67 to 1996 11 19.97					
	Mean	Max. & Date		Min. & Date	
R(I)	2.3	14	11/11	0	21 days
R(A)	2.6	14	10/26 & 11/11	0	19 days

In this rotation activity was elevated to the lofty heights of 'extremely low'. Still there were four Active Regions designated by SEC/NOAA; though the activity increased, the observations did the opposite. Only one observation was submitted in this rotation, by DeTraglia and it showed no spots on that day.

Table 7: Solar Cycle, Rotation 1916

DATES: from 1996 11 11.97 to 1996 12.09.28					
	Mean	Max. & Date		Min. & Date	
R(I)	20.4	57	11/25	0	6 days
R(A)	18.6	50	11/25-26	0	12/03 & 06

In only two rotations we jump from the lowest activity in this report to the maximum. Though this was the highest activity, still it only attained the category of 'very low'. Nine Active Regions were designated and, of these nine, there were only two observations of just one of the Active Regions, both Portoni whole disk white light drawings of AR7999.

On 11/26 Portoni, at 1411-25UT, observed this group, now with an area of 900-1000 millionths and class of Eki. This was easily the most developed group of this reporting period. On this day the leader was 4-5 umbrae in a comma-shaped penumbra with a curl to the E on the S end. In the middle of the group were three umbrae in a penumbra (possibly rudimentary), and the follower was six umbrae in one penumbra. There were some additional small umbral spots between the middle and follower spots.

In the second observation on the next day, Portoni showed that the group was smaller (with an area of 800-900 millionths) now an Ekc class. The leader was one large and three small umbrae in a single penumbra followed by the cut off tail of the comma shape or former middle spots containing 3-4 tiny umbrae. The follower was a cluster of three collections of small umbrae in rudimentary penumbrae. Clearly the group was decaying.

Table 8: Solar Cycle 23, Rotation 1917

DATES: from 1996 12 09.28 to 1997 01 05.61					
	Mean	Max. & Date		Min. & Date	
R(I)	13.8	22	12/13 & 18	0	6 days
R(A)	12.6	26	12/13 & 14	0	6 days

Activity in this rotation fell back from the high of the last rotation. Still categorized as 'very low' there were nevertheless six Active Regions designated but only two over 100 millionths. Observations by the Section fell to the lowest level thus far with no observations being submitted at all.

Table 9: Solar Cycle 23, Rotation 1918

DATES: from 1997 01 05.61 to 02 01.95					
	Mean	Max. & Date		Min. & Date	
R(I)	6.2	17	01/16	0	10 days
R(A)	6.3	16	01/16	0	7 days

In this rotation, activity fell even further to half of CR1917 and back into the 'extremely low' category. Again six Active Regions were designated, none over 50 millionths. Observers maintained the level of the last rotation as no observations were submitted.

Table 10: Solar Cycle 23, Rotation 1919

DATES: from 1997 02 01.95 to 1997 03 01.29					
	Mean	Max. & Date		Min. & Date	
R(I)	7.5	31	02/04	0	13 days
R(A)	7.9	27	02/03	0	9 days

Levels of activity were only slightly increased from the last rotation, but still extremely low. Four active regions were designated but all were less than 100 millionths in area and short lived. As with the last two rotations there were no observations submitted.

Table 11: Solar Cycle 23, Rotation 1920

DATES: from 1997 03 01.29 to 1997 03 28.60					
	Mean	Max. & Date		Min. & Date	
R(I)	7.7	25	03/15	0	12 days
R(A)	7.0	18	03/14	0	11 days

In CR1920 activity continued at extremely low levels. There were a few more regions designated, a total of seven, by SEC. The largest of these regions was AR8020 which managed to attain a maximum area of 150-200 millionths. Only one observer submitted observations, DeTraglia. Of his seven whole disk white light drawings, only three covered this sunspot group.

The first observation was on 03/10 (0030UT) when the region was already in decay with an area of only 50 millionths and a class of Cao. The leader was elongated N-S and consisted of two to three umbrae in penumbra only on the W and S sides. This was followed by a lone umbra. The next day the group had shrunk to 40 millionths but was still Cao. A DeTraglia drawing (2250UT) showed the leader as two umbrae with no penumbra followed by fragmentary penumbral bits. Two days later, 03/13 (2215UT) it was half as big and was only a collection of 8-9 umbrae with no penumbrae at all.

Table 12: Solar Cycle 23, Rotation 1921

DATES: from 1997 03 28.60 to 04 24.87					
	Mean	Max. & Date		Min. & Date	
R(I)	17.2	37	04/03	0	04/20-22
R(A)	19.4	43	04/03	0	04/20-21

The activity in this rotation rose to very low levels. There were nine Active Regions of which only two were observed by Section members and the observations were so sparse as to only provide a snapshot.

On 03/31 Garcia, in a region photograph (1707UT) and a whole disk white light photograph (1734UT), captured A8026 in decay and at this time only 80 millionths in area and class Dao. The leader was two spots, each with an umbra contained in rudimentary and fragmentary penumbrae. The follower spot was made up of five umbrae in rudimentary penumbra in a comma shape. A day later an H-alpha, whole disk image by Garcia showed the region to be fairly quiescent. The area was now 70 millionths but still class Dao.

AR8031 was first observed by Garcia on 04/13 in a region photograph at 1715UT of 2-3 arc seconds resolution. The leader was a line of umbrae with penumbra only to the N and S. In a middle region were pores and a few tiny umbral spots. The follower spot consisted of three to four umbrae in a symmetrical penumbra with one tongue of umbrae to the west that reached across the penumbra to the photosphere. Across the region from the middle umbrae to the follower spot were bits of fragmentary penumbrae. The area of this Dso group was 60 millionths. In an H-alpha, whole disk photo, again by Garcia, a bright region was seen between these three spot collections but otherwise the region was unremarkable.

Table 13: Solar Cycle 23, Rotation 1922

DATES: from 1997 04 24.88 to 1997 5 22.10					
	Mean	Max. & Date		Min. & Date	
R(I)	13.3	52	05/21	0	4 days
R(A)	14.8	69	05/21	0	05/01

Solar activity, though still low, fell back a bit in this closing rotation of this report. Even so, the number of Active Regions rose to ten. Participation by observers was also still low and we only have one observation of AR8040, the largest of this rotation.

On 05/21 Garcia, in a region photograph (1325UT) and a whole disk white light image (1358UT) showed the leader to be an E-W elongated, teardrop shaped umbra with radial penumbra. The tip of the teardrop cut off to the E. In the middle were a few pores with a follower to the E that was a collection of about a dozen small umbrae in rudimentary penumbra aligned in a right angle that was pointed N and W. The classification at this time was Cso with 100 millionths area.

Conclusion

This report covered a period during and just after sunspot minimum and the change over from Cycle 22 to 23. Activity was low to extremely low with those sunspot groups that did develop being of classes A-D and only one making it to E class. Unfortunately, observations decreased more than the activity itself. Even though it was minimum, there was still plenty of activity to observe, save for one rotation. More observations would have helped our understanding of the evolution of these sunspot groups. Perhaps, with better coverage, CR1914 would not have been completely spotless. Sunspot groups of modified Zurich Class (in the McIntosh system) of A and B can spring up and vanish in a matter of an hour or so. So these require vigilance and perseverance.

But readers take heart! As this is being written, we have just passed solar maximum with record numbers of observations and you can be assured that the situation in this report is only temporary.

References

For computation of R(I) numbers, positions, classifications and designations formerly the publication Solar-Geophysical Data (Prompt Reports), Part I, was used. As of this report, it has been replaced by downloaded data from the National Geophysical Data Center at: http://www.ngdc.noaa.gov/stp/SOLAR/getdata.html No other references were needed since even more was there than in the published hardcopy reports!

ALPO Feature:

ALPO Observations of Venus During the 1998 Western (Morning) Apparition

By Julius L. Benton, Jr., Coordinator, ALPO Venus Section

Abstract

This report is a concise summary of photo-visual observations contributed to the ALPO Venus Section by observers in the United States, Italy, and Germany during the 1998 Western (Morning) Apparition, including instrumentation and data resources used in making those observations. Comparative studies deal with observers, instruments, and visual and photographic data. The report includes illustrations and a statistical analysis of the categories of features in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, as well as coverage based on results from continued monitoring of the dark hemisphere of Venus for the Ashen Light.

Introduction

A total of 153 drawings and photographs of Venus was received by the ALPO Venus Section during the 1998 Western (Morning) Apparition. Geocentric phenomena in Universal Time (UT) for the Apparition are presented in *Table 1* (page 17), while *Figure 1* (page 18) illustrates the distribution of observations by month during the observing season.

Table 1: Geocentric Phenomena in Universal Time (UT) for the 1998 Western (Morning) Apparition of Venus

Inferior Conjunction	1998 Jan	16d 11h UT
Initial Observation	Jan	17 13
Greatest Brilliancy (mv = -4.6)	Feb	20 02
Greatest Elongation West (46.5°)	Mar	27 19
Dichotomy (predicted)	Mar	28 16
Final Observation	Oct	24 19
Superior Conjunction	Oct	30 04
Apparent Diameter (observed range): 62".47 (1998 Jan 17) - 9".73 (1998 Oct 24) *Phase Coefficient, k (observed range):* 0.005 (1998 Jan 17) - 0.999 (1998 Oct 24)		

ALPO observers monitored Venus reasonably well throughout the 1998 Western (Morning) Apparition, starting their observing programs just one day after Inferior Conjunction (which occurred on 1998 Jan 16) and continuing up to six days before Superior Conjunction on 1998 OCT 30. Such a consistent coverage of Venus throughout an apparition is a welcome trend that has been occurring in recent years. The "observing season," or observation period, ranged from 1998 Jan 17 to 1998 OCT 24, with over seven-eighths of the observations (88.2 percent) submitted for the period from 1998 February through August. In particular, the observations sharply peaked in 1998 February and March, the months in which Venus reached greatest brilliancy and maximum elongation from the Sun, respectively.

Seven individuals contributed visual and photographic observations of Venus during the 1998 Western (Morning) Apparition, and *Table 2* (page 18) gives their observing sites, number of observations, and instruments used.

Figure 2 (page 19) shows the distribution of observers and contributed observations by nationality of observer for the 1998 Western (Morning) Apparition. Nearly three-quarters of the individuals taking part in ALPO Venus programs (71.4 percent) resided in the United States and accounted for slightly more than half (51.0 percent) of the total observations received. Thus, during 1998, as in recent previous apparitions, international participation in our programs continued, supporting our efforts to foster increased cooperation among lunar and planetary observers worldwide.

The types of telescopes employed to perform observations of Venus in the 1998 Western Apparition are shown in the graph in *Figure 3* (page 19). It can be seen that the great majority (97.4 percent) of observations were made with telescopes 15.2 cm (6.0 in) in aperture or greater. Classical designs (refractors and Newtonians) were used in slightly over half (52.3 percent) of the observations, while most of the remainder (47.7 percent) of Venus reports were generated using Schmidt-Cassegrains, with one observation made using a Maksutov telescope. During the 1998 Western Apparition, nearly three-fourths of the observations (74.5 percent) occurred under dark sky conditions, with the remainder occurring in twilight. Some observers followed Venus after sunrise into broad daylight in an attempt to minimize the effects of overwhelming glare associated with the planet. Also, viewing Venus higher in the sky helped reduce the effects of atmospheric dispersion and image

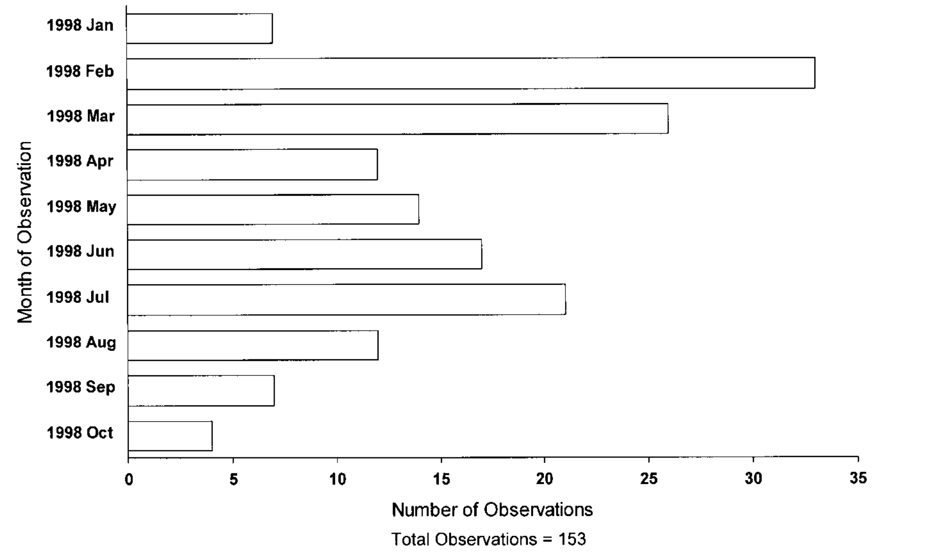

Figure 1. Number of Observations by Month, 1998 Western (Morning) Apparition of Venus.

distortion near the horizon, at least until late morning when solar heating caused image deterioration.

The ALPO Venus Section Coordinator extends his gratitude to the seven individuals mentioned in this report for their perseverance during early morning hours to study the planet and submit observations during the 1998 Western Apparition. Readers interested in finding out more about the Venus programs are urged to join the ALPO and become regular contributors to our observational pursuits in forthcoming apparitions.

Observations of Venusian Atmospheric Details

The standard methods and techniques for conducting visual studies of the vague and elusive "markings" in the atmosphere of Venus are outlined in detail in *The Venus Handbook* (Benton 1987). Readers who have access to earlier issues of this *Journal* may also find it helpful to consult previous apparition reports for a historical perspective on ALPO studies of Venus.

The observations used in this analysis were all made at visual wavelengths, and six examples of these observations in the form of drawings appear in this report to assist the reader in interpreting the phenomena reported in the atmosphere of Venus in the 1998 Morning Apparition. (See Figures 6-11 (pp. 21 and 22).

The visual and photographic data for the 1998 Western Apparition represented all of the traditional categories of dusky and bright markings in Venus's atmosphere (with the exception of radial dusky features), as described in the literature listed at the end of this report. *Figure 4* (page 20) shows the frequency that the specific forms of markings were seen or suspected. Most observations referred to more than just one category of marking or feature, and consequently totals exceeding 100 percent can occur. Readers should recognize that there is an inherent subjectivity that exists when visual observers attempt to try to describe the very elusive atmospheric markings of Venus, and this probably affected the data in Figure 4. Even so, the conclusions deduced from these data appear reasonable.

The dusky markings in the atmosphere of Venus are notoriously hard to see visually, a characteristic of the

Table 2: Participants in the ALPO Venus Observing Program During the 1998 Western (Morning) Apparition

Observer and Observing Site	Number of Observations	Telescope(s) Used*
Benton, Julius L., Jr.; Wilmington Island, GA	46	15.2-cm (6.0-in) REF
Boisclair, Norman J.; South Glens Falls, NY	1	8.9-cm (3.5-in) MAK
	1	20.3-cm (8.0-in) NEW
Frassati, Mario; Crescentino, Italy	10	20.3-cm (8.0-in) SCT
Haas, Walter H.; Las Cruces, NM	2	15.2-cm (6.0-in) NEW
	8	20.3-cm (8.0-in) NEW
Niechoy, Detlev; Göttingen, Germany	1	6.0-cm (2.4-in) REF
	60	20.3-cm (8.0-in) SCT
	4	30.5-cm (12.0-in) NEW
Post, Cecil; Las Cruces, NM	4	15.2-cm (6.0-in) NEW
	12	20.3-cm (8.0-in) NEW
Venable, Roger; Augusta, GA	2	12.8-cm (5.0-in) SCT
Total Number of Observers	7	
Total Number of Observations	153	
* MAK = Maksutov, NEW = Newtonian, REF = Refractor, SCT = Schmidt-Cassegrain.		

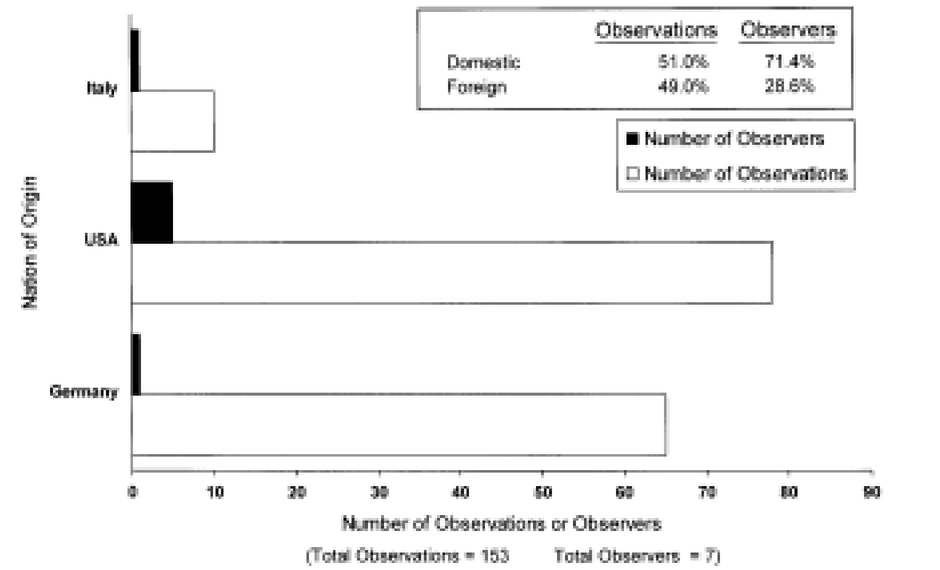

Figure 2. Number of Observations and Observers by Nationality, 1998 Western (Morning) Apparition of Venus.

planet that is mostly independent of the experience of the observer. Using color filters and variable-density polarizers helps reveal subtle cloud phenomena on Venus at visual wavelengths, but the ALPO Venus Section strongly encourages observers to attempt regular UV (ultraviolet) photography. The morphology of features revealed at UV wavelengths is typically different from what is seen in visual regions of the spectrum, particularly with the radial dusky patterns.

Figure 4 shows that about one-third (32.7 percent) of the observations of Venus in the 1998 Western Apparition referred to a brilliant disk completely devoid of markings. When dusky features were seen or suspected, most fell in the categories of “Banded Dusky Markings” (46.9 percent), “Amorphous Dusky Markings” (45.1 percent), and “Irregular Dusky Markings” (47.8 percent). There were no sightings of “Radial Dusky Markings” during the 1998 Western (Morning) Apparition.

Terminator shading was apparent during much of the 1998 observing season, reported in 75.8 percent of the observations, as shown in Figure 4. The terminator shading usually extended from one cusp region to the other, and the shading appeared to lighten (i.e., take on a higher intensity) as one progressed from the region of the terminator toward the bright limb of the planet. This gradual variance in brightness ended in the Bright Limb Band in most accounts. No photographs in the 1998 Western Apparition clearly showed any hint of terminator shading.

The mean relative intensity for all of the dusky features on Venus in the 1998 Western Apparition ranged from 8.0 to 8.5, where 0.0 represents black and 10.0 the brightest possible features. The ALPO Scale of Conspicuousness (which runs sequentially from 0.0 for “definitely not seen” up to 10.0 for “certainly seen”) was also used regularly during this apparition. On this scale, the dusky markings in Figure 4 had a mean conspicuousness of about 3.0 during the apparition, which suggests that these features fell within the range between very indistinct impressions and fairly good indications of their actual presence on Venus.

Figure 4 also shows that “Bright Spots or Regions,” exclusive of the cusp areas, were not seen or suspected in any of the submitted observations. When seen, it is customary in drawings made at visual wavelengths for

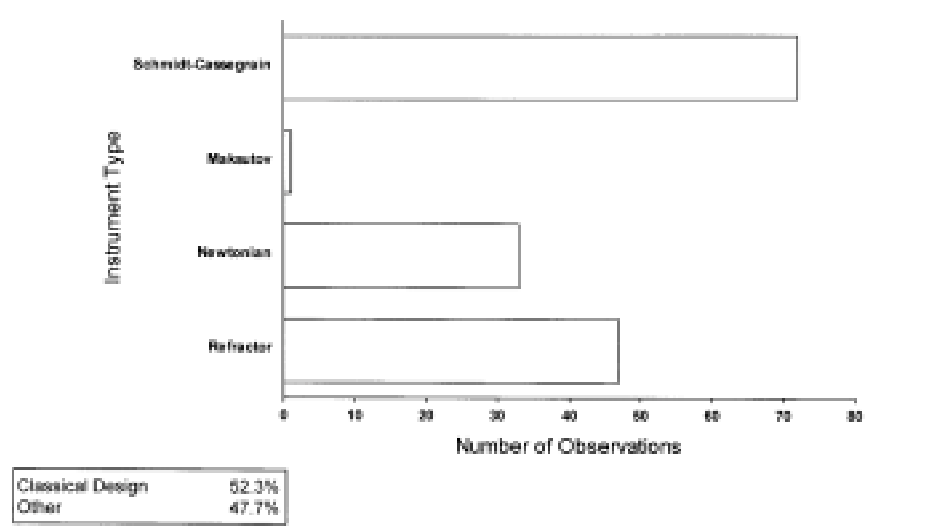

Figure 3. Number of Observations by Type of Telescope, 1998 Western (Morning) Apparition of Venus.

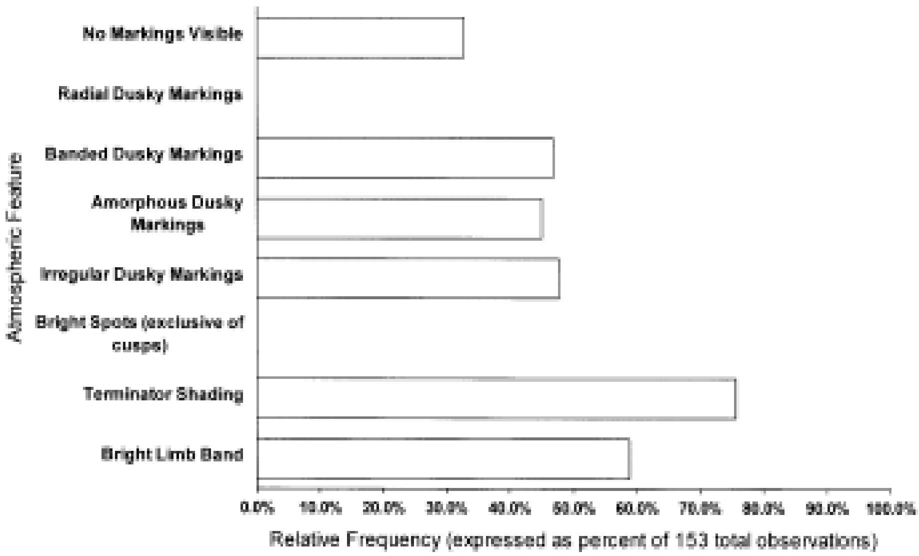

Figure 4. Relative Frequency of Specific Forms of Atmospheric Markings, 1998 Western (Morning) Apparition of Venus.

observers to call attention to such bright areas by sketching dotted lines around such features.

Observers regularly used color-filter techniques during the 1998 Western (Morning) Apparition, and when results were compared with studies in Integrated Light (no filter), it was clear that color filters and variable-density polarizers helped improve the visibility of elusive atmospheric phenomena on Venus.

The Bright Limb Band

Figure 4 reveals that 58.8 percent of the submitted observations in the 1998 Western Apparition reported a “Bright Limb Band” on Venus’s sunlit hemisphere. When the Bright Limb Band was reported, it appeared as a continuous, brilliant arc extending from cusp to cusp for only 28.6 percent of the observations, and was interrupted or only partially visible along the limb of Venus in 71.4 percent of the positive reports. This impression by observers in 1998 is in sharp contrast with other recent apparition reports. The mean numerical intensity of the Bright Limb Band was 9.7, becoming more obvious when color filters or variable-density polarizers were employed. Despite the dazzling brilliance of this feature for visual observers, it was not apparent in any photographs of Venus submitted in 1998.

Terminator Irregularities

The terminator is the geometric curve that divides the sunlit and dark hemispheres of Venus. Observers described an irregular or asymmetric terminator in a little less than one-third (30.1 percent) of the observations in the 1998 Western Apparition. Amorphous, banded, and irregular dusky atmospheric markings appeared to blend with the shading along the terminator, possibly contributing to reported deformities. Filter techniques enhanced the visibility of terminator irregularities, and dusky atmospheric features closely associated with them, during this apparition. Because of irradiation, bright features adjacent to the terminator may occasionally look like bulges, and dark features may look like dusky hollows.

Cusps, Cusp-Caps and Cusp-Bands

In most cases, when the *phase coefficient*, **k**, the fraction of the disc that is illuminated, lies between 0.1 and 0.8,

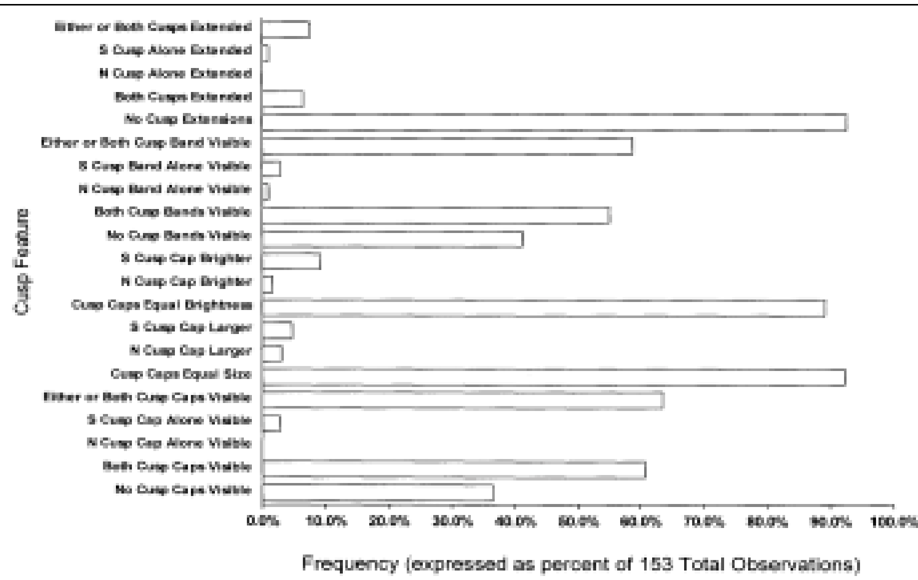

Figure 5. Relative Frequency of Observations of Specific Cusp Features, 1998 Western (Morning) Apparition of Venus.

NOTE: The six drawings that follow are all oriented with celestial south at the top and celestial west at the left, which is the normal inverted view when observing objects near the meridian with an astronomical telescope in the Earth's Northern Hemisphere. (Figures 6 and 7 were originally reversed and have been rectified.) Seeing was reported, or has been converted to, the standard ALPO scale, ranging from 0.0 for the worst possible condition to 10.0 for perfect seeing. Transparency is on the ALPO Scale, ranging from 0 for worst to 5 for perfect.

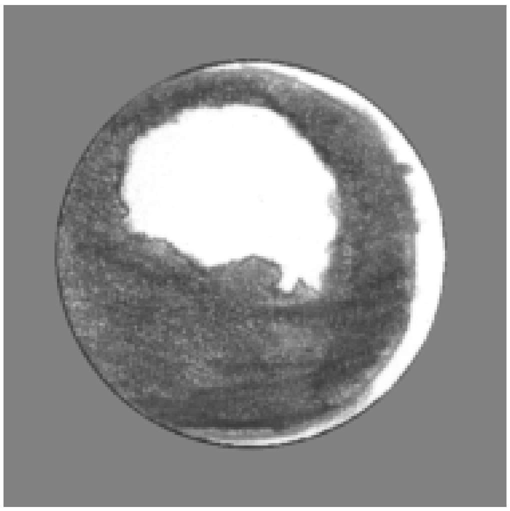

Figure 6. 1998 Feb 02, 11:43 UT. Detlev Niechoy, Göttingen, Germany. 20.3-cm (8.0-in) Schmidt-Cassegrain, 51X, Integrated Light. Seeing 2.5, Transparency 2.5. Ashen Light definitely visible. Phase (k) = 0.098, Diameter = 53".5.

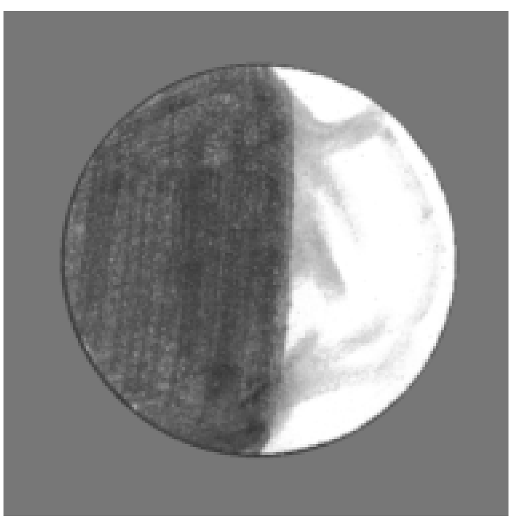

Figure 7. 1998 Mar 26, 05:46 UT. Detlev Niechoy, Göttingen, Germany. 20.3-cm (8.0-in) Schmidt-Cassegrain, 112X, Integrated Light. Seeing 2.0, Transparency 2.0. Phase (k) = 0.486, Diameter = 25".0.

features on Venus having the most contrast and prominence are repeatedly sighted at or near the planet's cusps. These cusp-caps are sometimes bordered by what are described as dark, usually diffuse, cusp-bands. Figure 5 (page 20) shows the visibility statistics for Venusian cusp features in the 1998 Western Apparition.

Figure 5 shows that the northern and southern cusp-caps of Venus, when observed, were equal in size and brightness most of the time. There were a very few instances when either the northern or southern cusp-cap was the larger, the brighter, or was both, and in slightly more than one-third of the observations submitted (36.6 percent), neither cusp-cap was visible. The mean relative intensity of the cusp-caps was about 9.9 during the 1998 Western Apparition. Dusky cusp-bands bordering the bright cusp-caps were not reported in 41.1 percent of the observations when cusp-caps were visible, and the cusp-bands displayed a mean relative intensity of about 6.8 (see Figure 5).

Cusp Extensions

As shown in Figure 5, there were no cusp extensions reported beyond the 180° expected from simple geometry for 92.8 percent of the observations (both in integrated light and with color filters). Early in the apparition, as Venus progressed through its crescentic phases following inferior conjunction in 1998, several observers recorded cusp extensions that ranged from 2° to 15°. Just after inferior conjunction, a few observers thought that the cusps joined along the planet's unilluminated limb, forming a beautiful halo encircling the dark hemisphere of Venus. Reported cusp extensions were shown on drawings, with their appearance enhanced by color filters and polarizers, but none were photographed successfully. Experience has shown that cusp extensions are very difficult to document on film due to the fact that the sunlit regions of Venus are so much brighter than the faint extensions. We encourage observers to try recording cusp extensions with CCD or video cameras in future apparitions.

Estimates of Dichotomy

A discrepancy between the predicted and the observed dates of dichotomy (half-phase), known as the "Schroeter Effect" on Venus, was not reported by observers during the 1998 Western (Morning) Apparition as no observers submitted phase estimates during the apparition. The predicted half-phase occurs when k = 0.500, and the *phase angle*, **i**, between the Sun and the Earth as seen from Venus equals 90°.

Dark-Hemisphere Phenomena and Ashen-Light Observations

The Ashen Light, first reported by G. Riccioli in 1643, refers to an extremely elusive, faint illumination of

Venus's dark hemisphere. Although it does not have the same origin, the Ashen Light resembles Earthshine on the dark portion of the Moon. Most observers agree that Venus must be viewed against a completely dark sky for the Ashen Light to be seen, but such circumstances occur only when the planet is very low in the sky where adverse terrestrial atmospheric conditions contribute to poor seeing. Also, substantial glare in contrast with the surrounding dark sky influences such observations. Even so, the ALPO Venus Section continues to hear from observers who say they have seen the Ashen Light when Venus was against a twilight sky.

During the 1998 Western Apparition, there were practically no instances (2.6 percent of the observations) when the Ashen Light was seen or suspected in Inte-

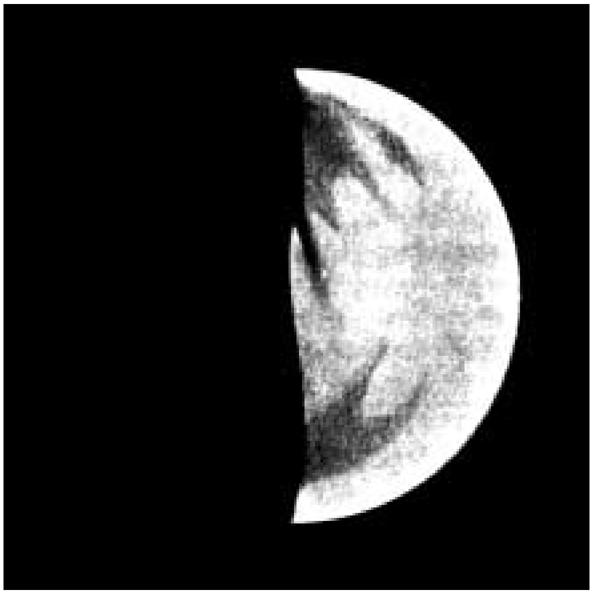

Figure 8. 1998 Mar 29, 08:10 UT. Mario Frassati, Crescentino, Italy. 20.3-cm (8.0-in) Schmidt-Cassegrain, 222X, W8 (light yellow) Filter. Seeing 2.0 (interpolated). Terminator irregularities; cloud extending over terminator? Phase (k) =0.502, Diameter = 24".1.

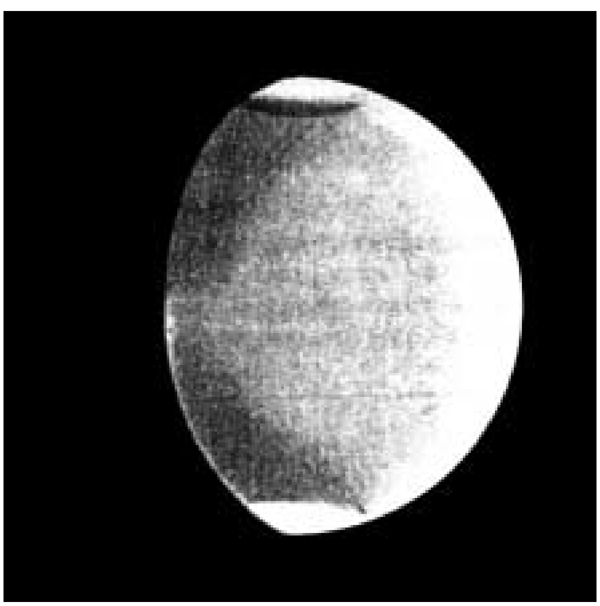

Figure 9. 1998 June 16, 10:00 UT. Mario Frassati, Crescentino, Italy. 20.3-cm (8.0-in) Schmidt-Cassegrain, 250X, W80A (light blue) Filter. Seeing 6.5 (interpolated). Phase (k) = 0.802, Diameter = 13".1.

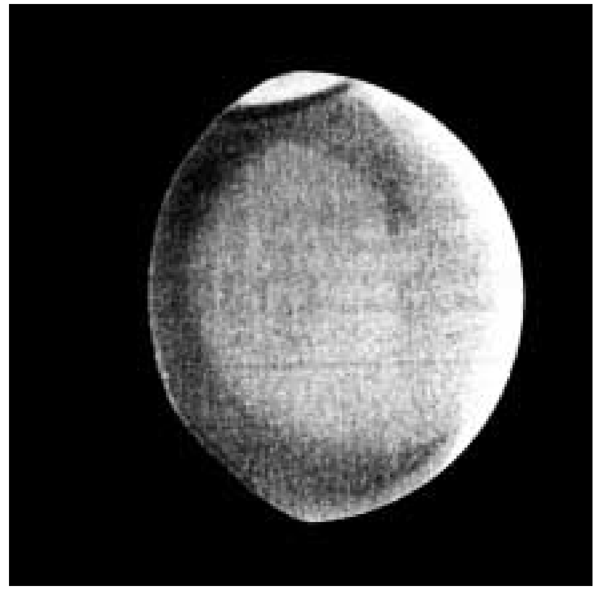

Figure 10. 1998 July 10, 08:25 UT. Mario Frassati, Crescentino, Italy. 20.3-cm (8.0-in) Schmidt-Cassegrain, 250X, W80A (light blue) Filter. Seeing 7.0 (interpolated). Phase (k) = 0.865, Diameter = 11".8.

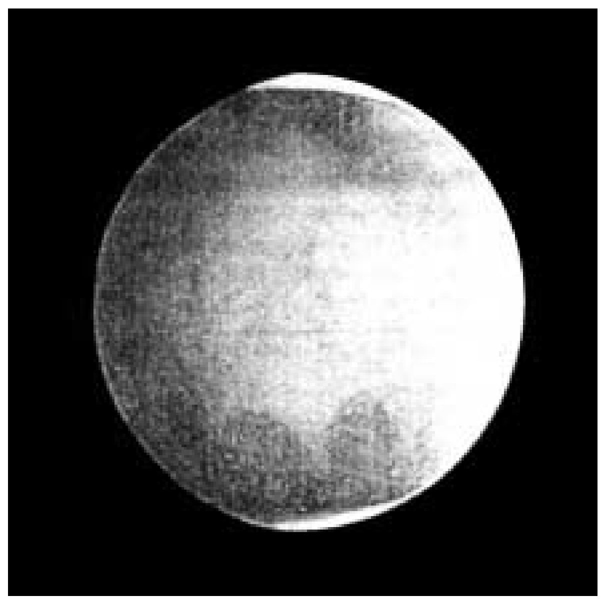

Figure 11. 1998 AUG 25, 08:32 UT. Mario Frassati, Crescentino, Italy. 20.3-cm (8.0-in) Schmidt-Cassegrain, 250X, W80A (light blue) Filter. Seeing 6.0 (interpolated.) Phase (k) = 0.954, Diameter = 10".3.

grated Light, or with color filters or variable-density polarizers. On 1998 Jan 31, 11:34 to 11:40 UT, veteran Venus observer Detlev Niechoy of Göttingen, Germany reported that the Ashen Light was definitely visible in blue light and in Integrated Light (no filter) using his 20.3-cm (8.0-in) Schmidt-Cassegrain at 112X, and he described the Ashen Light as also "definite" on 1998 Feb 02, 11:43 to 12:02 UT, in Integrated Light and with a blue filter but not with W25 (red), W15 (yellow), and W47 (dark blue) filters. No other observers reported any suspicions of the phenomenon, and unfortunately, there were no confirmations of the two Ashen Light sightings by Niechoy.

Indeed, there were a few instances during the 1998 Western (Morning) Apparition (7.2 percent) when observers described the dark hemisphere of Venus as looking *darker* than the background sky, this phenomenon is almost surely an effect of contrast.

Conclusions

The results of our analysis of visual and photographic observations contributed to the ALPO Venus Section during the 1998 Western (Morning) Apparition of Venus indicated limited activity in the atmosphere of Venus. It was mentioned earlier in this report that it is very troublesome to differentiate between what constitutes real atmospheric phenomena and what is merely illusory on Venus at visual wavelengths. The level of confidence in our results will improve as the number of observers and incidence of simultaneous observations increase. The Venus Section is making a special effort to organize and implement simultaneous observation schedules so that observers near each other can set aside mutual times to jointly follow Venus using similar methods and equipment. The simultaneous observing schedule is expected to appear on the ALPO Website in the very near future at www. lpl.arizona.edu/alpo. In addition to routine observations, the Venus Section desperately needs more ultraviolet photographs of Venus, as well as CCD images of the planet at different wavelengths. We are attempting to standardize and improve observational techniques and methodology so that comparison of our results with those of previous morning observing seasons, as well as with evening apparitions of Venus, is more reliable.

ALPO studies of the Ashen Light, which peaked during the Pioneer Venus Orbiter Project, are continuing every apparition. Constant monitoring of the planet for the presence of this phenomenon by a large number of observers (ideally participating in a simultaneous observing program) remains important as a means of improving our chances of capturing confirmed dark-hemisphere events.

Active international cooperation by individuals making regular systematic, simultaneous observations of Venus remains our main objective, and the ALPO Venus Section invites interested readers to join us in our projects and challenges ahead.

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(From the ALPO Venus Section Mission Statement)

"Visual observations of the planet Venus should be carried out in a cooperative systematic research program to maximize opportunities for useful scientific contributions. In the A.LPO Venus Section, our objective is to observe Venus on every possible clear night throughout an apparition of the planet, which runs from conjunction to subsequent conjunction with the Sun. Venus is an inferior planet, meaning that it has a smaller interior orbit to that of the Earth, and it exhibits phases just like the Moon. Because Venus is comparatively near the Sun, it is characteristically very bright, and the high albedo produces an excessive amount of glare. The rather faint and elusive markings on the disk of Venus, normally of very low contrast, become difficult to see as a result. Considerable controversy exists over the true nature of these dusky amorphous or somewhat streaky atmospheric features. It is not at all unusual for two observers, working on the same date with comparable instrumentation, to see strikingly dissimilar atmospheric phenomena on the planet."

ALPO Feature:
The Nature of the Hook-Like Shadow on Plato's Floor Observed by Wilkins and Moore in 1952
Part II. Simulations with a Computer and a Plasticine® Model

By: Giancarlo Favero[a], Raffaello Lena[b], Fabio Lottero[b] and Marco Fiaschi[c]

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Introduction

A paper recently appeared in this Journal [1] which proposed that the hook-like shadow recorded on the floor of the lunar crater Plato by Wilkins and Moore on 1952 April 3, [2, 3], is projected by a complex and elongated hill lying on Plato's floor, at the foot of its south wall. The hill is easily visible on Lunar Obiter IV images [1] and has coordinates eta = 0.7693, xi = –0.0875 (latitude 50.29°, longitude –7.87°). Some Italian authors [4] and an ALPO editor [5] maintained another opinion expressed by O'Connell in 1998 [6], that the hook shadow is shed by the gamma peak (peak #3 in paper [1]), the tallest of the Plato's east rim peaks.

We carried out a computer simulation of the 1952 drawings and built a Plasticine® model of Plato in order to demonstrate that:

- The hook-like shadow recorded on the Wilkins and Moore drawings is compatible with the shadow of the complex and elongated hill, as suggested in paper [1].
- The gamma peak shadow cannot appear where the hook-like shadow is reported in the drawings, regardless of the illumination conditions.
- The gamma peak shadow never displays significant curvature so it cannot be the hook shadow.

Experimental

A. Computer Simulation of the 1952 Shadows

The original two Plato drawings made on 1952 April 3, 21^{h} 30^{m} UT [2, 3] are reproduced here as *Figures 1* and *2*. Each one was scanned and digitally converted to obtain the contour of: the crater rim, the hook-like shadow, the shadow cast on Plato's floor by its east wall, the shadows of a few features lying on Plato's east wall and the shadows of a few features lying outside Plato's wall. We selected for our simulation only those features of the last two types which were identifiable in both drawings.

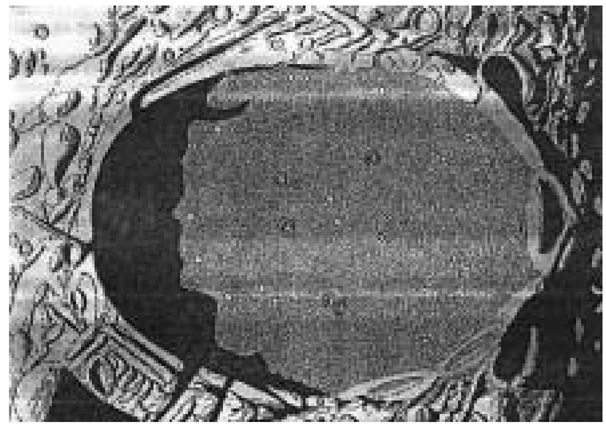

Figure 1: Plato drawn by H. P. Wilkins on 1952 April 3, at 21h 30m UT, observing the Moon with the Meudon *grande lunette* of 83 cm (altitude of the Sun over Plato, H = 5.32°; azimuth of the Sun, A = 94.95°). The hook-like shadow near the south-east wall is evident. South is up, or nearly so, in all the figures.

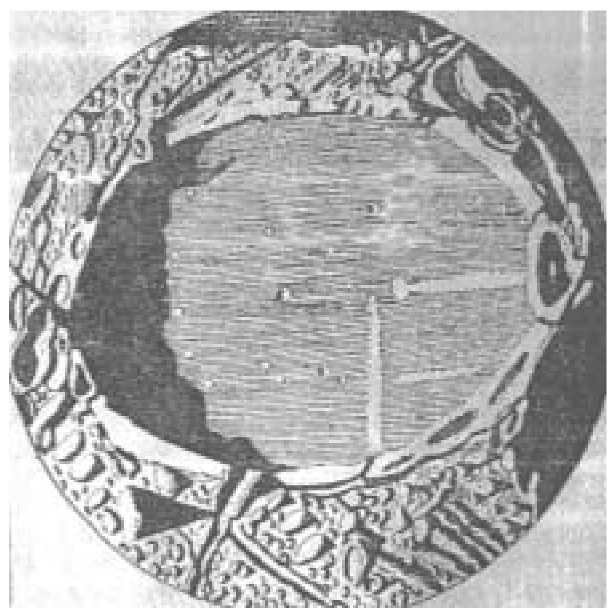

Figure 2: Plato drawn at the same time as Figure 1 by P. Moore, observing with the same instrument. Features on Plato's floor are similar, in particular the "hook", while those outside the crater are crudely different, revealing that the authors were concerned with few features on the floor.

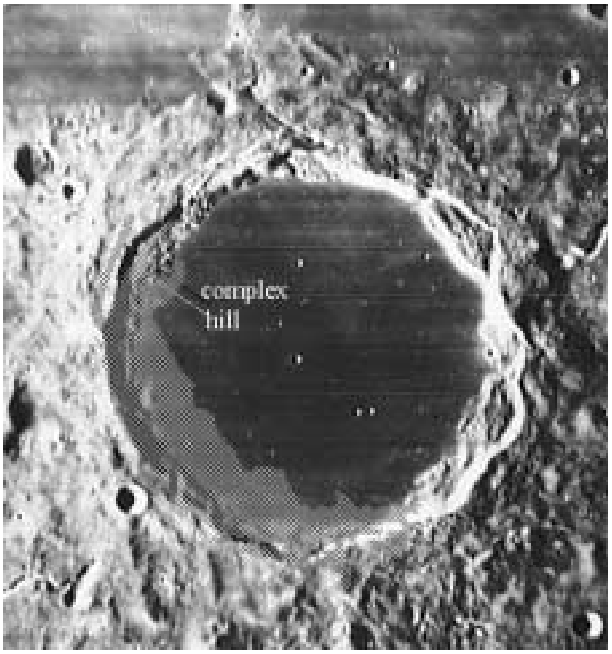

Figure 3: The best fit between some shadows of the Wilkins's drawing (reticulated) and the corresponding features on the Lunar Orbiter IV image IV-127-H3

The digital image of each drawing was measured on the computer screen to obtain, in units of pixels, the length of Plato's major and minor axes. Along the same two directions, identified by the same geological features, we measured the corresponding diameters of Plato on the image IV-127-H3 taken by Lunar Orbiter IV 1967 May 20, 6^h 26^m UT (Sun's height over Plato, H = 20.79°; Sun's azimuth, A = 117.47°). The digital image

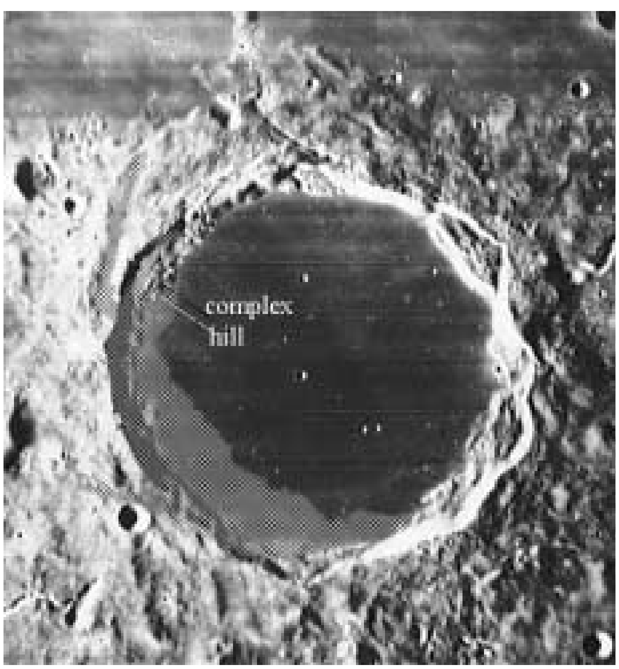

Figure 4: The best fit between some shadows of the Moore's drawing (reticulated) and the corresponding features on the Lunar Orbiter IV image IV-127-H3

of each drawing was then stretched and rotated to give the best superimposition over the Lunar Orbiter image. It is worth noting that the hook-like shadow was not considered in these operations. The best fit obtained with this procedure is shown in *Figure 3* for the Wilkins drawing and in *Figure 4* for the Moore drawing.

B. The Plasticine® Model

A 6 inch diameter (150 mm) 3-D model of Plato's east wall and floor (*Figure 5*), at the scale of about 1:670.000, was built by layering Plasticine® over a copy of the Lunar Orbiter photo described above.

Figure 5: The Plasticine® model built for this work. The lighting is similar to O'Connell's image [4] and to *Figure 3* in [1]: H = 3°; A = 95°.

The height in kilometres of different portions of Plato's east wall was calculated with the ALPO Lunar Observer's Tool Kit software from the relevant shadow lengths measured in units of pixels on *Figure 3* of [1] and is reported in Table 1.

The height of each measured portion of Plato's east wall, resampled with the proper scale ratio, was built up with Plasticine®. The height was determined with a centesimal calliper (0.05 mm precision, corresponding to 33 m, or 106 ft, on the Moon). Each calibrated portion was then connected to the nearby ones so as to obtain shadows like those recorded on the CCD images taken under similar lighting conditions. The slope of Plato's inner wall was obtained by connecting the wall rim with the scarp base recorded on the Lunar Orbiter photo. The Moon's curvature was neglected.

Table 1: Coordinates, shadow lengths and peak heights of peaks 1 through 9 from Figure 3b of article [1]. For some of the valleys (a-h) eta values are also reported, but not their xi values, because the position of the highest feature on the bottom of a valley can differ considerably at different sunlight inclinations.

Peak (1,2 …) valley (a,b ...)	eta	xi	Shadow (pixels ±1)	Height (km ± 0.03)
a	0.7683		40	1.29
1	0.7700	-0.0822	43	1.39
2	0.7715	-0.0800	47	1.52
b	0.7723		40	1.29
3	0.7724	-0.0759	65	2.10
c	0.7750		37	1.20
4	0.7800	-0.0727	46	1.49
d	0.7814		40	1.29
5	0.7830	-0.0719	49	1.58
6	0.7859	-0.0716	53	1.71
e	0.7886		30	0.97
7	0.7905	-0.0729	39	1.26
f	0.7921		32	1.03
8	0.7941	-0.0748	40	1.29
g	0.7959		30	0.97
9	0.7968	-0.0769	35	1.11

Table 2: Coordinates, shadow lengths and heights of the complex and elongated hill from measurements from figure 7 in [1].

Peak	eta	xi	Shadow (pixels ± 1)	Height (km ± 0.03)
ch	0.7693	-0.0875	3	0.50

The white-painted model was placed in a dark room, illuminated by a beam of sunlight, and photographed with a camcorder. Different sequences were recorded modifying the Sun's height and azimuth. A few frames of suitable sequences were digitally converted and they are shown as *Figures 5-7*.

We included some key geological features on this model (*Figure 6*). First, we put the complex and elongated hill proposed in [1] as the cause of the hook-like shadow, adopting a height of 500 m (1550 ft) measured by its shadow in Figure 7 of [1] and calculated with the ALPO *Lunar Observer's Tool Kit* software (Table 2). A few smaller hills lying on Plato's floor at the foot of its east wall were also included, to improve the shadows' contour for the Sun's height around 10°. The four craterlets reported on the 1952 drawings were also added to the model, with exaggerated wall heights. Also, we added to the model (*Figure 6*) the meridian passing through the gamma peak and a protractor arc, with its center on the gamma peak, to indicate the Sun's azimuth, referred to the same peak, from 90° to 120° in 5° increments.

Results and Discussion

A. Computer elaboration of the 1952 shadows

The digital copies of the 1952 drawings were computer resampled to simulate Plato's perspective as shown in the IV-127-H3 Lunar Orbiter IV photo. Each resampled drawing was then superimposed on that photo to give the best fit between a few selected features appearing on both pertaining to Plato's wall rim and the neighboring terrain. The hook-like shadow was deliberately neglected in this procedure, so its final position was only the result of the best fit among the other selected features. The results are reported in *Figures 3* and *4* which show the shadows from Wilkins and Moore, respectively, superimposed on the Lunar Orbiter photo IV-127-H3. In both figures the hook-like shadow closely encircles the north-west base of the complex and elongated hill, as one would expect if the hill is the source of the hook, as suggested in paper [1].

B. The Plasticine® Model

The fidelity of our Plato Plasticine® model (*Figure 5*) is demonstrated by its ability to simulate fairly well the shadows appearing in the O'Connell CCD image [6] and in *Figure 3* of paper [1]. An interesting result provided by the model is that the complex and elongated hill, proposed in paper [1] as the source of the hook-like shadow, can actually cast a shadow of that geometry in the correct position, as *Figure 6* clearly shows (compare *Figure 6* with *Figures 1* and *2*).

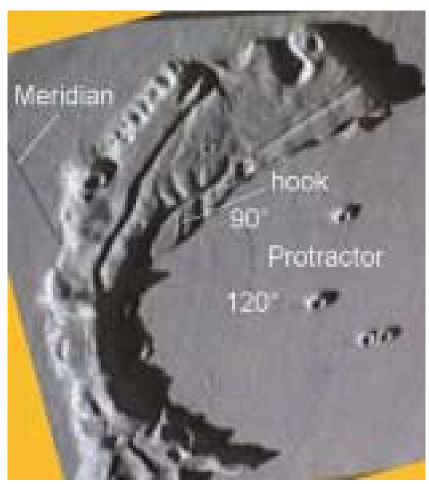

Figure 6: Plato's model illuminated like the CCD images of Figures 6 and 7 in [1]: H = 11°; A = 105°. The meridian passing through the gamma peak, the 90°-120° protractor and the hook-like shadow are indicated.

Figure 7: The gamma peak's shadow would combine with the complex and elongated hill's shadow only for a Sun's azimuth of 80° and 10° Sun's height. Only thus the model would be similar to the 1952 drawings, but this azimuth is impossible.

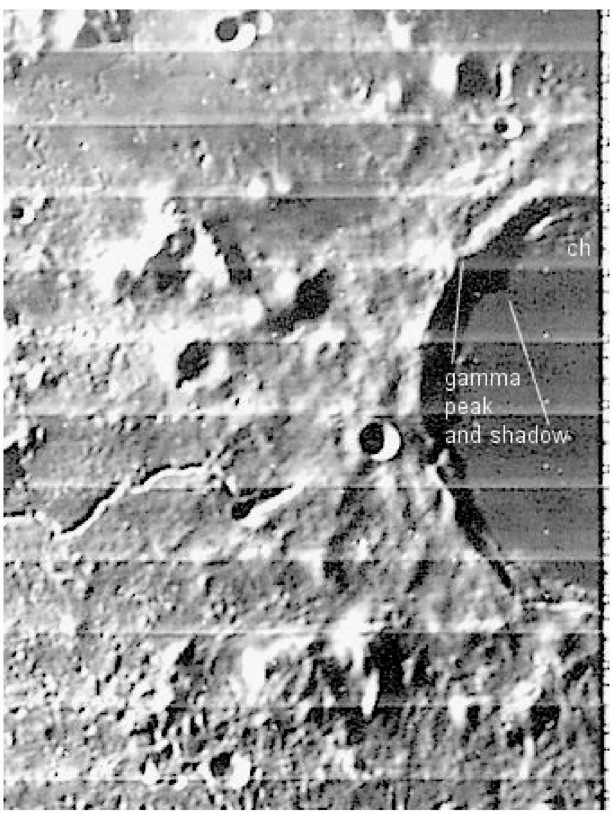

Figure 8: Image IV-116-H1 of Lunar Orbiter IV taken 1967 May 19, $7^h\ 00^m$ UT (H = 15.71°; A = 109.02°). The gamma peak shadow is well visible, northward of the curved shadow of the complex and elongated hill (ch), which appears like the hook shadow of the 1952 drawings.

A further result concerns the gamma peak shadow (peak and shadow #3 in paper [1]). The gamma peak's shadow is the longest shadow, measured from the east wall rim to the shadow's tip, on Plato's floor under any lighting condition. It should coincide with the 1952 hook as proposed by O'Connell only for solar azimuth values lower than 80°. This azimuth of 80° is the azimuth simulated in Figure 7, where the gamma peak shadow is cast near the elongated hill in which case it appears similar to the 1952 hook.

But an azimuth of 80° is clearly impossible, so the gamma peak shadow can NEVER be in the place of the 1952 hook. While the Sun rises over the gamma peak, its shadow on Plato's floor shortens and shifts northward, because of the rising of Sun and because of its increasing azimuth. This is confirmed by the image IV-116-H1 of Lunar Orbiter IV taken 1967 May 19, 7h 00m UT (H = 15.71°; A = 109.02°) and reported here as Figure 8.

Figure 8 shows the gamma peak shadow in a position more northern than the 1952 hook. Moreover, Figure 8 shows the top of the complex and elongated hill near the Plato's southern wall: the top of the hill is illuminated by the Sun. The north-western base of the hill is encircled by shadows recorded by Lunar Orbiter. These shadows cannot be seen with the same resolution by an earth based observer. Integrated by an earth-based observer, these shadows combine to give the hook.

Why is the gamma peak shadow not reported on the 1952 drawings?

If what precedes is correct, we must search for an answer to this question.

We think that the two Plato drawings made at the telescope on 1952 April 3 by the two English observers were originally only rough and incomplete sketches of a few features upon which their attention was directed. This hypothesis is supported by their words [2, page 236]: "The shaded drawing [of Plato reported on page 234] …. may be relied upon as depicting, with accuracy, the relative size and intensities of the cratercones, spots and streaks (?) visible under that particular angle of illumination." The question mark concerns the absence of any streak from the Wilkins drawing (*Figure 1*), while three streaks are well evident in the Moore drawing (*Figure 2*). We can thus maintain that the observers recorded at the telescope only these few features, including the hook-like shadow, which appears similarly in the two drawings. Completing from memory their drawing in a later time, the two observers forgot to report the gamma peak shadow (probably confounding it with the hook) and introduced a considerable amount of rough differences in the Plato's neighborhoods, which can be seen by comparing features between *Figure 1* and *2*.

This hypothesis is sustained by the following reconstruction of the 1952 April 3 minimal observing schedule based on “The Moon” [2] even though a precise time scale is lacking:

- Wilkins “saw a distinct craterlet on the summit of the central mountain [of Alpetragius], surrounded by four almost overhanging peaks. This was at once confirmed by Moore… (page 138).
- Wilkins “critically examined Conon…”. It follows a detailed description of the observed features (page 94).
- Moore … noted ten objects on the floor [of Archimedes], only four of which appeared as distinct craterlets.” It follows a detailed description of the observed features (page 92).
- Wilkins and Moore “discovered … a white, very shallow crater within which is a most minute central pit, the whole strongly resembling a “washbowl” (page 228).
- At $21^h\ 30^m$ UT the observers sketch Plato at the same time (page 234).
- Between $22^h\ 00^m$ and $22^h\ 15^m$ UT Wilkins draws Guerické (page 127).
- At $22^h\ 15^m$ UT Moore “first distinctly sees a craterlet where A and Birt join…” (page 140, the year "1951" reported on the figure caption is clearly a misprint, as confirmed by the accompanying text which states that the observation was done on “3 April 1952”.)

The two observers studied Plato for not more than 30 minutes, 15 minutes each one, to cover all of those observations. It appears impossible that an observer, even an expert, could complete at the telescope a drawing as detailed as the ones in *Figure 1* or *2* in this little time.

In conclusion, we suggest that the 1952 drawings contain a number of common features which attracted the attention of both observers. These certainly include the hooked shadow, whose shape and position seem accurate under the limits of a visual observation. All other features, particularly those outside Plato but also some shadows on Plato’s floor (as we will show later), have only a vague counterpart in reality.

Comparing the 1952 Drawings with a Similar CCD Image

Figure 9 allows a comparison between the 1952 drawings and a CCD image (Figure 4 in [1]) taken under nearly the same illumination conditions: H = 5.32° in the drawings and 5.15° in the CCD frame; A = 94.95° in the drawings and 98.59° in the CCD frame. The reported values are referred to the top of the gamma peak.

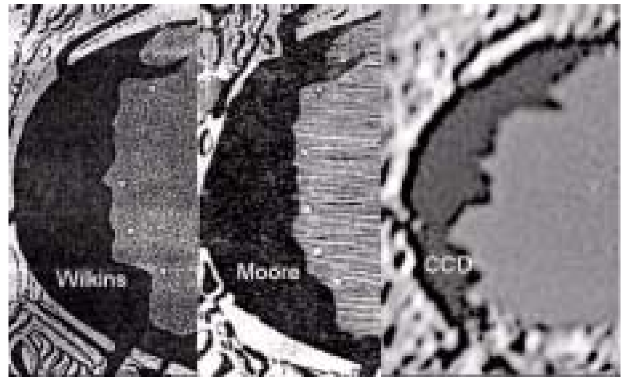

Figure 9: Comparison between the 1952 drawings and a CCD image taken under similar light conditions (H = 5.15°; A = 98.50°). The CCD image shows the westward extension of the shadow south of the gamma peak’s shadow, while the shadow’s portion south of the hook is restricted toward east.

The shadow cast by Plato’s east wall onto its floor appears much more extended in the drawings than in the CCD image, particularly in its northern half. This fact in itself suggests a time for the drawings earlier than $21^h\ 30^m$ UT. However this cannot be true, because the mean height of the east wall mountains diminishes northward (Table 1). This is confirmed by all the images reported in [1], also those added by the ALPO editor. It can be concluded that the shape and extension of the shadow of the Plato east wall which appear in the 1952 drawings were not recorded at the telescope. Therefore this shadow cannot be relied upon.

As far as the hook-like shadow is concerned, *Figure 9* reveals that it appears more eastward in the drawings, particularly in the Moore one, and more southward than the gamma peak shadow in the CCD image. We are sure that the hook was recorded accurately by the two observers in their 1952 drawings, so that three conclusions may be drawn:

- The time of these drawings may be later than $21^h\ 30^m$ UT (according to Moore, as reported in [1]).
- The hook-like shadow cannot be identified with the gamma peak shadow, because of the different position of these two features.
- The gamma peak shadow doesn’t show any “hook” curvature in the CCD image, which has a very high quality (pixel scale about 0.8 km).

Now we wish to compare, in *Figure 9*, the portion of the shadow between the hook (or the gamma peak shadow) and Plato’s south wall. The CCD image shows that this portion of the shadow is much extended westward, so as to largely extend beyond the longitude of the shadow tip of the gamma peak. On the opposite case, the drawings show that the shadow between the hook and the south wall is strongly receded eastward. This should confirm that the drawings were made considerably later than the time recorded, but the situation isn't so simple.

If Plato's floor was perfectly flat in the region under examination, the shadow width should have receded regularly with the Sun's rising, nearly maintaining its original western profile. In other words, the portion of shadow between the south wall and the hook (or the gamma peak shadow) should have maintained a larger extension westward of the hook-like shadow (or the gamma peak shadow). We are convinced that the strong eastward shift of the shadow south of the hook in the 1952 drawings is due to the emersion of the complex and elongated hill (height about 500 m, 1550 ft) from the east wall shadow, as shown in *Figure 8*. By now the hill casts his shadow westward originating the hook-like shadow, while the gamma peak shadow continues to be visible, more northward than the hook and progressively confused with the inner portions of Plato's east wall shadows. This happens when the Sun's height over Plato's gamma peak exceeds about 8°, i.e., just after 24^h UT on 1952 April 3, when the Moon was about 20° high over the Meudon horizon.

Conclusions

The Plato drawings made by Wilkins and Moore on 1952 April 3 show crude differences between them and a similar CCD image as far as the crater neighborhoods are concerned. To explain these differences we suggest that the English observers each executed at the telescope only a partial drawing intended only to record a few features on Plato's floor, including the hook-like shadow which appears similarly recorded by both. On this basis we try to explain also the absence from the drawings of the gamma peak shadow and the anomalous shape of the east wall shadow, which was recorded by a CCD in similar lighting conditions.

Computer simulations of the features similarly recorded on the 1952 drawings, including the hook-like shadow, allowed their comparison with the IV-127-H3 Lunar Orbiter IV image. *Figures 3* and *4* sustain the hypothesis that the hook shadow is cast by the complex and elongated hill situated on the crater floor, near its south wall, as suggested in [1]. Accordingly, we can also explain the rapid receding of the shadow comprised between the hook and Plato's south wall.

Our Plasticine® Plato model, illuminated under different Sun conditions, sustains this hypothesis and discards the involvement of the gamma peak shadow in the formation of the hook. In fact, the gamma peak shadow remains visible, but sensibly northward of the hook, in any lighting condition from H = 3° and A = 94° to H = 11° and A = 105°, simulated by our model, and certainly up to H = 13.93° and A = 107.27° of the Lunar Orbiter IV image IV-116-H1.

References

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[2] Wilkins, H. P. & Moore, P., *The Moon*, 2nd Ed., Faber and Faber Ltd, London, 1961, p. 236 (Wilkins drawing).

[3] Wilkins, H. P., *Our Moon*, Frederick Muller Ltd, London, 1958, p. 70 (Moore drawing).

[4] Braga, R. & Ferri, F., "Plato Hook: l'Uncino di Plato", http://www.uai.it/sez_lun/hook.htm

[5] "Three Additional Views of the 'Hook' Shadow on Plato's Floor", *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 42, 2000, number 3, p. 132.

[6] O'Connell, B., "Plato Hook. Clementine and CCD images shed light on the shadowy mystery of a 45 year old drawing", Proceedings of the 49th Convention of the ALPO, Atlanta, Georgia, July 9-11, 1998, *ALPO Monograph No 8*.

Note on Figures 1 and 2

Wilkins's and Moore's drawings (Figures 1 and 2) can be reproduced without permission from the publishers because:

1. The Faber and Faber Editor no longer holds the "The Moon" rights, as told to us by Sally Robson (sally.robson@faber.co.uk) who suggested we ask A P Watt Ltd.

2. A. P. Watt does not hold the rights of the book, as told to us by Melanine Rigg, apw@apwatt.co.uk)

3. The editor of the book *Our Moon*, Frederick Muller Ltd, London, is no more active following 1985.

ALPO Feature:
Observations of the Remote Planets in 2000

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Abstract

Over a dozen people studied the remote planets of our solar system, Uranus, Neptune and Pluto in the year 2000 and this report summarizes those observations. The selected normalized magnitudes of Uranus are: B(1,0) = -6.56, V(1,0) = -7.14±0.01, R(1,0) = -6.82±0.01 and I(1,0) = -5.62±0.05 while the corresponding value for Neptune is: V(1,0) = -6.98±0.02. During 1991-2000, Uranus became dimmer in the V filter at an average rate of 0.0020 magnitudes per year while Neptune became 0.0112 magnitudes per year brighter in the same filter. Unfiltered CCD images show Titania to be 0.24 magnitudes brighter than Oberon on August 6, 2000. Unfiltered CCD images made in 1998 and 2000 are consistent with the Pluto system being brightest at a sub-Earth longitude of 130° and dimmest at 280°.

Introduction

Two recent developments related to the remote planets were the detection of "clouds" on Uranus from ground-based telescopes (Sromovsky et al. 2000, 307) and the construction of a two-color map of Pluto's sub-Charon hemisphere (Young, Binzel and Crane, 2001, 552). Sromovsky and co-workers used the NASA Infrared Telescope Facility to image Uranus at several wavelengths including 1.7 microns in mid-1998 and mid-1999. They detected faint clouds in 1998 and a bright cloud in 1999. They point out the need for further studies to determine if Uranus is about to undergo a period of increased cloud activity. Young, Binzel and Crane (2001, 552) analyzed Charon occultation data to construct a color map of Pluto. A dark feature just south of Pluto's equator was resolved and it is concluded that this feature is comprised of several distinct color units.

In addition to the two breakthroughs mentioned in the preceding paragraph, professional astronomers continue to monitor the clouds on Neptune in infrared wavelengths (Roddier et al. 1998, 168), (Talcott, 2001, 30). Wasserman, Olkin and Franz (2000, 1082) used Hubble Space Telescope images to measure a Charon/Pluto mass ratio of 0.122±0.005. Finally, Frank Melillo of the Association of Lunar & Planetary Observers (ALPO) recorded methane-band images of Uranus on five different nights in 2000.

Table 1 lists the characteristics of the 2000 apparitions of Uranus, Neptune and Pluto. Sixteen people submitted observations of the remote planets between mid 2000 and early 2001; their names, locations and types of observations are listed in Table 2.

Table 1: Characteristics of the 2000 apparitions of Uranus, Neptune and Pluto.[a]

Parameter	Uranus	Neptune	Pluto
First conjunction date	2000 Feb. 6	2000 Jan. 24	1999 Dec. 3
Opposition date	2000 Aug. 11	2000 July 27	2000 June 1
Angular diameter (opposition)	3" .7	2″.4	0" .1
Right Ascension	$21^h 26^m$	$20^h 30^m$	$16^h 46^m$
Declination	$-15° 52^m$	$-18° 46^m$	$-10° 57^m$
Second conjunction date	2001 Feb. 9	2001 Jan. 26	2000 Dec. 7

[a] Data is taken from the *Astronomical Almanac* ©1998, 1999, and 2000a

Photoelectric Photometry

Five people submitted photoelectric magnitude measurements of the remote planets in 2000. In all cases, an SSP-3 solid-state photometer was used along with filters that were transformed to the Johnson B, V, R and I system; more information on the instrument and filters can be found elsewhere (Optec, 1997), (Schmude, 1992, 20). Katie used a 0.09 meter Maksutov telescope in making her measurements. Both Frank and Brian used a 0.20 meter Schmidt-Cassegrain telescope in making their measurements, while John made all of his measurements with a 0.13 meter Schmidt-Cassegrain telescope. The author used a 0.51 meter Newtonian in May and June but used a 0.09 meter Maksutov telescope during September. Table 3 lists the comparison stars used in the photoelectric magnitude measurements.

All measurements were corrected for both atmospheric extinction and transformation. Transformation coefficients were computed using the two-star method outlined in Hall and Genet (1988, 200). The transformation coefficients for Frank's equipment are: ε_V = -0.038 and ε_I = -0.16.

Table 2: People who contributed remote planets observations in 2000.

Observer and Location	Type of Observation *
Phil Barker; Christchurch, New Zealand	V
Ray Berg; Crown Point, IN, USA	C, V, VP
Norman Boisclair; South Glens Falls, NY, USA	C, V
Brian Cudnik; Weimar, TX, USA	C, V, VP
Robert English; Franklin, TN, USA	V
Robin Gray; Winnemucca, NV, USA	C, V, VP
Walter Haas; Las Cruces, NM, USA	H, VP
Rik Hill; near Tucson, AZ, USA	VP
Raffaello Lena and others; Italy	CCD, V
Brian Loader; Christchurch, New Zealand	PP
Frank Melillo; Holtsville, NY, USA	CCD, CCD-P, PP, S, M
Katie Moore; Williamson, GA, USA	PP
Richard Schmude, Jr.; Barnesville, GA, USA	VP, PP
Tòfol Tobal and others; Spain	V
Roger Venable; Augusta, GA, USA	V
John Westfall; Antioch, CA, USA	PP
*C = Color; CCD = CCD image, CCD-P = CCD photometry, H = Historical data, M = methane band data, PP = photoelectric photometry, S = Spectra, V = visual observations or drawing, VP = eyeball magnitude	

John reports a value of ε_I = -0.129±0.017. Loader's transformation coefficients are reported in (Schmude, 2000b, 159). During May/June, the author used a 0.51 meter Newtonian telescope along with a photometer having transformation coefficients of: ε_B = 0.037, ε_V = -0.065, ε_R = -0.024 and ε_I = -0.135. In September, the author and Ms. Moore used a 0.09 meter Maksutov telescope and photometer having values of: ε_B = 0.092, ε_V = -0.051, ε_R = -0.021 and ε_I = -0.095.

All photoelectric magnitude measurements of Uranus are listed in Table 4 while those of Neptune are listed in Table 5. In most cases, a measurement consisted of the sequence CPCPCPC where C is the comparison star reading and P is the Uranus (or Neptune) reading. Except in rare cases, each measurement is the average of between 3 and 5 P measurements. The selected normalized magnitudes are listed in Table 6.

The V-filter measurements of Loader, Melillo, Moore and Schmude correspond to normalized magnitudes of -7.12, -7.14, -7.15 and -7.15, which are all consistent with one another. The infrared magnitudes of Melillo and Westfall correspond to normalized magnitudes of: -5.88 and -5.61; the difference between these two values is 0.27 magnitudes, which is too large. As a result of this discrepancy, I would like to recommend four things for all future photoelectric magnitude measurements: 1) always use a check star in making measurements, 2) take several sets of sky, comparison star, target, and check star measurements, 3) use a comparison star that has a B-V value close to that of the target object and 4) use a dew shield when making measurements.

The V(1,0) values of Uranus and Neptune over the last 10 years are plotted in Figure 1. Small color corrections were made to the 1991-1995 and 1997 data since these corrections were not made in the original papers. The data were fitted to a linear least squares routine and it was found that Uranus became 0.0020 magnitudes per year dimmer during the 1990s while Neptune became 0.0112 magnitudes per year brighter during that same time period. Most of the dimming for Uranus, however, took place between 1991 and 1996; during these years, Uranus became dimmer at an average annual rate of 0.0048 magnitudes. Lockwood and Thompson (1999, 3) carried out an excellent study of Uranus using the Strömgren b (4720 Å) and y (5510 Å) filters where the peak wavelength is given in parentheses. (The symbol Å means angstrom; 1.0 Å = 1.0 x 10^{-10} meter). Lockwood and Thompson's study extends from 1972 through 1996. Their y-filter data shows Uranus getting 0.1 magnitudes brighter between 1972 and 1985 and getting 0.06 magnitudes dimmer between 1989 and 1996. The average dimming rate between 1989 and 1996 is around 0.008 magnitudes per year, which is larger than the 0.0048 magnitude/year rate measured by ALPO members. The higher dimming rate measured by Lockwood and Thompson may be due to the y-filter being almost centered on a methane absorption band; see Figure 2. If methane absorption had increased, then it would explain the extra dimming of Uranus in the y-filter. The Johnson V filter used by ALPO members, however, would be less affected by increased methane absorption since it covers a large wavelength range; see Figure 2.

During the 1990s, Neptune was brightest around 1999; this is 1 to 2 years from solar maximum. This result is different from the trend observed in the 1970s and 1980s, where Neptune was dimmest at solar maximum (Lockwood and Thompson, 1986, 1543). Hammel and Lockwood (1997, 466) report that a dark belt became less distinct in the mid 1990s, which may explain the 0.04 magnitude brightness increase at a wavelength of 5510 Å which they observed between 1989 and 1994. The brightening trend of Neptune shown in Figure 1 is also consistent with the results of Lockwood and Hammel (2000, 1009).

Table 3: Summary of the comparison stars used in the photoelectric and CCD magnitude measurements made in 2000.

Star Name	Right Ascension[a]	Declination[a]	Magnitude			
			B	V	R	I
Gamma-Cap	21^h 40.1^m	-16° 40^m	---	---	---	3.22[b]
45-Cap	21^h 44.0^m	-14° 45^m	---	5.96[c,d]	---	---
Theta-Cap	21^h 05.9^m	-17° 14^m	4.08[b]	4.07[b]	4.06[b]	---
Rho-Cap	20^h 28.9^m	-17° 49^m	5.18	4.80	---	---
HD 195859	20^h 34.5^m	-19° 24^m	---	7.82 [c,e]	---	---
Star a	16^h 40.80^m	-10° 57.4^m	---	~12.5[f]	---	---
Star b	16^h 42.95^m	-10° 57.4^m	---	~13.9[f]	---	---

[a] All positions are from Hirshfeld, Sinnott and Ochsenbein (1991).

[b] Magnitudes are from Iriarte et al. (1965).

[c] Magnitudes are from the Tycho Catalog

[d] A value of B-V = 0.21 was used for the transformation corrections; this B-V value is from Hirshfeld, Sinnott and Ochsenbein (1991).

[e] A value of B-V = 0.4 was used for the transformation corrections; this B-V value is from Hirshfeld, Sinnott and Ochsenbein (1991).

[f] Based on an average Pluto magnitude of 13.7 and unfiltered CCD images.

"Eyeball" Magnitude Estimates

Six individuals made 77 and 60 eyeball magnitude estimates of Uranus and Neptune respectively in 2000. Essentially, these people compared the brightness of these two planets to nearby comparison stars with only a telescope or binoculars. The average normalized magnitudes are: -7.1±0.01 and -6.9±0.01 for Uranus and Neptune respectively. Only random errors are included in the uncertainty for the normalized magnitudes. Hollis (2000, 124) reports a mean brightness magnitude for Uranus of +5.59±0.171, which is equivalent to $V_{vis}(1,0)$ = -7.12; this is close to the value selected for the 2000 apparition. Hollis (1999, 278) also reports a mean brightness of 7.76±0.19 for Neptune between 1989 and 1997 which corresponds to a mean normalized magnitude of -6.95.

Appearance of Uranus and Neptune

Phil Barker and Robin Gray suspected a bright area on Uranus near the limb on June 8 and Oct. 17 respectively. A similar spot was observed by myself 12 years earlier and was independently confirmed by others (Schmude, 1988, 87). Limb darkening was noted in about half of the Uranus and Neptune observations. Brian Cudnik suspected a bright area near Neptune's north pole that was bordered by a darker band. No other disc irregularities were reported on Neptune except for limb darkening. Twelve color estimates were reported for Uranus and of these, there were an equal number of blue and green hues reported. I have tabulated the color estimates of Uranus based on the colors of blue and green; the results are: blue (3), green (3), blue-green (3), blue to blue green (2) and yellow (1); the number of observations for each color is in parentheses. It is concluded that Uranus had an equal amount of blue and green color in 2000. The color estimates for Neptune are: blue (4) and blue-green (1) and so it is concluded that Neptune displayed a bluish hue with little or no green in 2000. These selected colors are also in agreement with observations made by European observers.

Roger Venable reports that he got better views of Uranus using the traditional one-eye view compared to using a binocular viewer. This is probably due to the binocular viewer splitting the light in half and giving each eye half of the light that it would receive through just a single eyepiece.

Frank Melillo used a 0.20 meter telescope along with a CCD camera on Sept. 1, 2000 (3:30 U.T.) to image Uranus; the image scale was 1 pixel = 0.5 arc-seconds. Frank reports no cloud features on Uranus, but he does report a pronounced limb darkening of the planet.

Frank Melillo used a methane band filter with a peak transmission of light having a wavelength of 8900 Å along with a 0.20 meter telescope and a CCD camera to image Uranus. The methane band filter was purchased from Andover Corporation of Salem, New Hampshire and is 0.0070 meters thick. The images made with this filter are called "methane band images" because 8900 Å is a wavelength of light that methane absorbs; methane band images of Uranus and Neptune are more likely to show albedo features than integrated light images. A total of 16 images were made on Aug. 22, 23, Sept. 7, 8 and 22, and from these, Frank detected no change in brightness and concludes that any change would be less

Table 4: Measured and normalized magnitudes of Uranus made in 2000 based on photoelectric measurements.

Date – U.T.	Filter	Magnitude		Comparison Star
		Measured (+)	Normalized (-)	
May 7.386	V	5.85	7.10	Gamma-Cap
May 16.763	V	5.87	7.12	45-Cap
June 7.316	V	5.82	7.13	Gamma-Cap
June 7.351	V	5.79	7.16	“
June 7.357	V	5.77	7.18	“
Aug. 6.229	V	5.75	7.13[a]	Theta-Cap
Aug. 6.240	I	7.03	5.86[a]	“
Aug. 17.177	V	5.75	7.13[a]	“
Aug. 17.188	I	7.01	5.88[a]	“
Aug. 21.167	V	5.75	7.14[a]	“
Aug. 21.177	I	6.98	5.90[a]	“
Sept. 5.232	I	7.27	5.62	Gamma-Cap
Sept. 6.266	I	7.27	5.63	“
Sept. 7.258	I	7.27	5.62	“
Sept. 8.267	I	7.23	5.67	“
Sept. 18.104	V	5.77	7.14[a]	Theta-Cap
Sept. 18.115	I	7.05	5.86[a]	“
Sept. 19.281	I	7.30	5.62	Gamma-Cap
Sept. 20.230	I	7.32	5.59	Gamma-Cap
Sept. 21.252	I	7.32	5.60	“
Sept. 24.235	I	7.33	5.59	“
Sept. 25.261	I	7.30	5.62	“
Sept. 27.221	I	7.31	5.62	“
Sept. 28.107	B	6.36	6.56	Theta-Cap
Sept. 28.078	V	5.78	7.14	“
Sept. 28.134	R	6.10	6.83	“
Sept. 29.076	R	6.12	6.80	“
Sept. 29.095	R	6.13	6.80	“
Sept. 29.114	R	6.11	6.81	“
Sept. 29.134	R	6.04	6.88	“
Sept. 29.153	R	6.10	6.83	“
Sept. 29.176	R	6.11	6.82	“
Sept. 29.197	R	6.09	6.84	“
Sept. 29.209	I	7.35	5.58	“
Sept. 29.215	R	6.14	6.78	“
Oct. 2.193	I	7.31	5.62	Gamma-Cap
Oct. 4.220	I	7.31	5.62	“
Oct. 7.236	I	7.39	5.55	Gamma-Cap
Oct. 17.197	I	7.35	5.61	“
Oct. 19.220	I	7.43	5.53	“
Oct. 22.144	I	7.33	5.63	“
Oct. 29.025	V	5.78	7.19	Theta-Cap
Oct. 29.049	V	5.82	7.15	“
Nov. 1.155	I	7.33	5.65	Gamma-Cap
Nov. 17.116	I	7.38	5.63	“

[a] These measurements are based on just one set of measurements and are given a ¼ weight.

than 0.1 to 0.2 magnitudes. Unfortunately, Frank was unable to make quantitative brightness estimates of Uranus due to a low signal-to-noise ratio.

Spectroscopy

Melillo imaged the spectra of both Uranus and Neptune; the dates and times of the Neptune spectra are: August 17, 2000 (4:15 U.T.) and Aug. 21, 2000 (4:15 U.T.). One of his spectra is shown in Figure 2. Essentially, Melillo used a spectroscope sold by Rainbow Optics and imaged the spectra with a CCD camera. He used Starlight Express software for Uranus to first stretch the spectrum and then take an intensity row in the spectrum, which was converted into the intensity-versus-wavelength graph in Figure 2. The procedure was the same for Neptune, except that Maxlm DL software was used. The sharp drops in intensity in Figure 2 are called absorption bands. The absorption bands near 5400, 6200, 7200, 7950, 8900 and 9900 Å are caused by the methane in the atmosphere of Uranus absorbing light at these wavelengths. Other absorption bands near 5750, 6670, 6970 and 8540 Å are present in the Uranus spectrum while additional absorption bands at 5740, 6640, 6890 and 7850 Å are present in the Neptune spectrum. The intensity of light at 4500 Å divided by that at 5400 Å was measured from the spectra of both planets; the resulting quotients are: 0.7 for Uranus and 0.5 for Neptune. These results may be due to differences in the atmospheric transparency on the dates that the spectra were imaged, or the spectra may show that the reflectivity of Neptune drops off more steeply at shorter wavelengths.

The ratio of the depth of the methane absorption bands near 5400, 6200 and 7200 Å to the peak intensity were evaluated for 1999 and 2000. The bands near 5400 and 6200 Å were deeper in 1999 than in 2000, but the reverse was the case for the 7200 Å band, and so no firm conclusions can be made regarding changes in the methane absorption bands between 1999 and 2000. It is important for members to continue to record the spectra of Uranus and Neptune in the future so that the methane absorption bands can be monitored.

Titania, Oberon and Triton

Melillo recorded two unfiltered CCD images of Uranus, Titania and Oberon on

Table 5: Measured and normalized magnitudes of Neptune made in 2000 based on photoelectric measurements

Date – U.T.	Filter	Magnitude		Comparison Star
		Measured (+)	Normalized (-)	
May 1.382	V	7.74	7.04	Rho-Cap
May 16.739	V	7.79	6.97	HD 195859
June 7.292	V	7.74	7.00	Rho-Cap
June 7.334	V	7.79	6.95	"
June 7.375	V	7.78	6.96	"

Aug. 6 (5:45 U.T.) under excellent seeing conditions. Titania was 0.22 and 0.27 magnitudes brighter than Oberon in two different frames. These results are intermediate between those in 1998 and 1999. For 1998-2000, Titania is, on average, 0.21±0.04 magnitudes brighter than Oberon which is consistent with the literature value (*Astronomical Almanac*, 2000b). Melillo also recorded images of Neptune and Triton on Aug. 17 (4:10 U.T.) and Aug. 21 (4:04 U.T.). Melillo reports that Triton may be fainter at southern elongation than at western elongation; unfortunately, the interference from Neptune was too great to do precise photometry of Triton by itself.

Pluto

Melillo made a series of CCD images of the Pluto system, hereafter referred to as "Pluto", along with two comparison stars ("stars a" and "b" in Table 3) between July 2 and 9. He essentially imaged Pluto along with two comparison stars using two 30-second exposures, which were combined into one image. The relative brightness of Pluto and star a was measured for each date; furthermore, the relative brightness between stars a and b was measured and it was found that the magnitude differences between these stars remained within 0.06 magnitudes of the average difference. The longitude of the sub-Earth point on Pluto (*Astronomical Almanac*, 1999, E78) was also computed for each of Frank's measurements; the results are shown in Figure 3. The 1998 Pluto data summarized elsewhere (Schmude, 2000a, 17) were also plotted as a function of the longitude of the sub-Earth point on Pluto (*Astronomical Almanac*, 1997, E78) and this is also shown in Figure 3. Different comparison stars were used in 1998 and 2000, and so one cannot combine the data into one graph; nevertheless, one can see an overall agreement between the two graphs. The two brightness minima recorded by Melillo were compared to a brightness minimum measured by Binzel and Mulholland (1984, 1760) on Julian date 2,445,434.763. Melillo's two brightness minima were measured on June 2.16, 1998 (Julian date = 2,450,966.66) and July 7.16, 2000 (Julian date = 2,451,732.66). The difference between Melillo's two times is 766.0 days which equals 119.93 Pluto rotations while the difference between Frank's 2000 measurement and Binzel and Mulholland's measurement is 6297.897 days, which equals 986.02 Pluto rotations; a rotational period of 6.3872 days for Pluto was used (*Astronomical Almanac*, 2000b, E88). These results confirm the stability of the bright and dark areas on Pluto. I conclude that the Pluto system is brightest when the sub-Earth longitude is near 130° and is dimmest near 280°.

The difference between maximum and minimum brightness as Pluto rotates has changed from 0.14 magnitudes in 1954 to 0.28 magnitudes in 1982 (Stern, Trafton and Gladstone, 1988, 486). In 1998-2000, the variation was near 0.4 magnitudes. Stern, Trafton and Gladstone (1988, 485) predict that the variation in Pluto's rotation curve will begin to decline between 1996 and 2006. It is important for ALPO members to continue to monitor the brightness of Pluto as it rotates. Another prediction by Stern and co-workers was that Pluto's geometric albedo will begin to rise after 1989. (The year 1989 was the date of perihelion passage.)

Table 6: : Selected normalized magnitudes for Uranus and Neptune in 2000.

Planet	B(1,0)	V(1,0)	R(1,0)	I(1,0)
Uranus	-6.56	-7.14±0.01	-6.82±0.01	-5.62±0.05
Neptune	---	-6.98±0.02	---	---

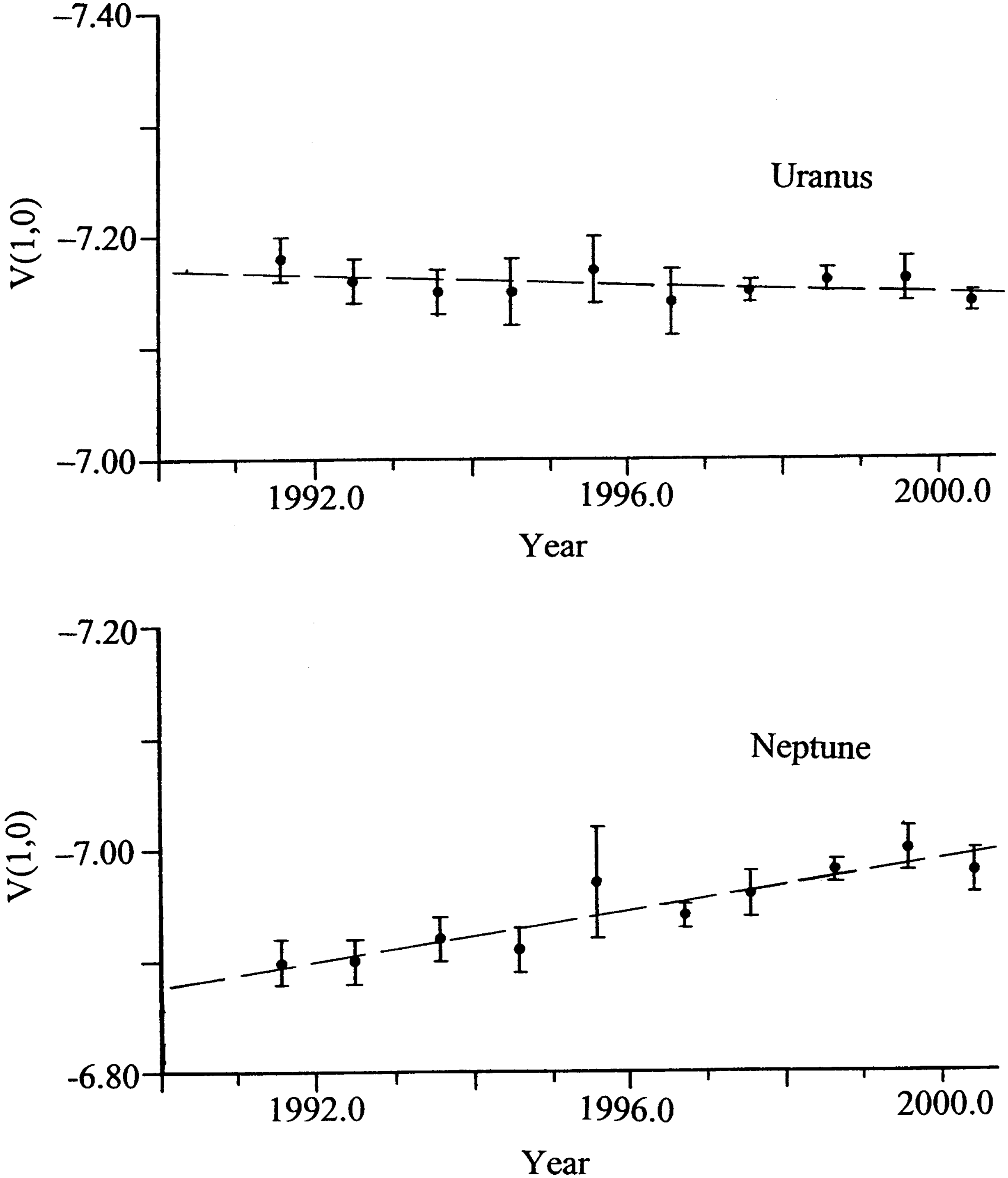

Figure 1: Plots of the normalized magnitudes of Uranus and Neptune versus the year from 1991 to 2000.

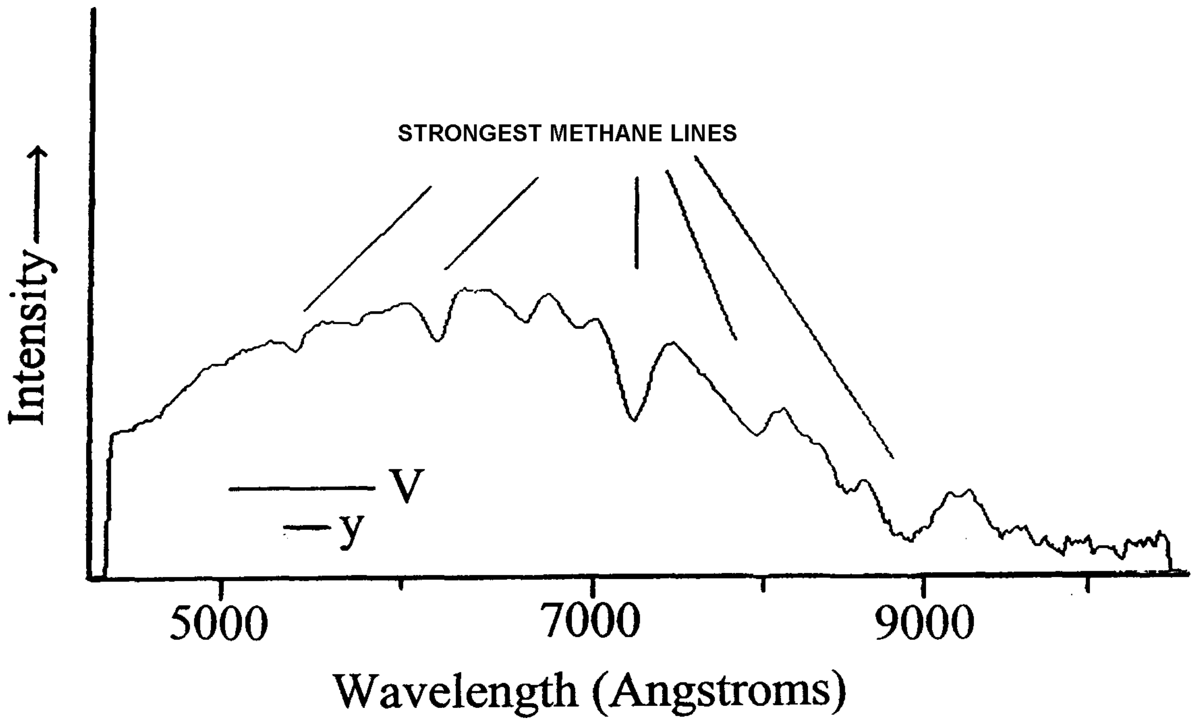

Figure 2: The spectrum of Uranus recorded by Frank Melillo on Aug. 27, 2000 at 5:30 U.T. Also shown are the effective wavelengths and bandpasses for the Johnson V filter (designated as V) and the Strömgren y filter (designated as y).

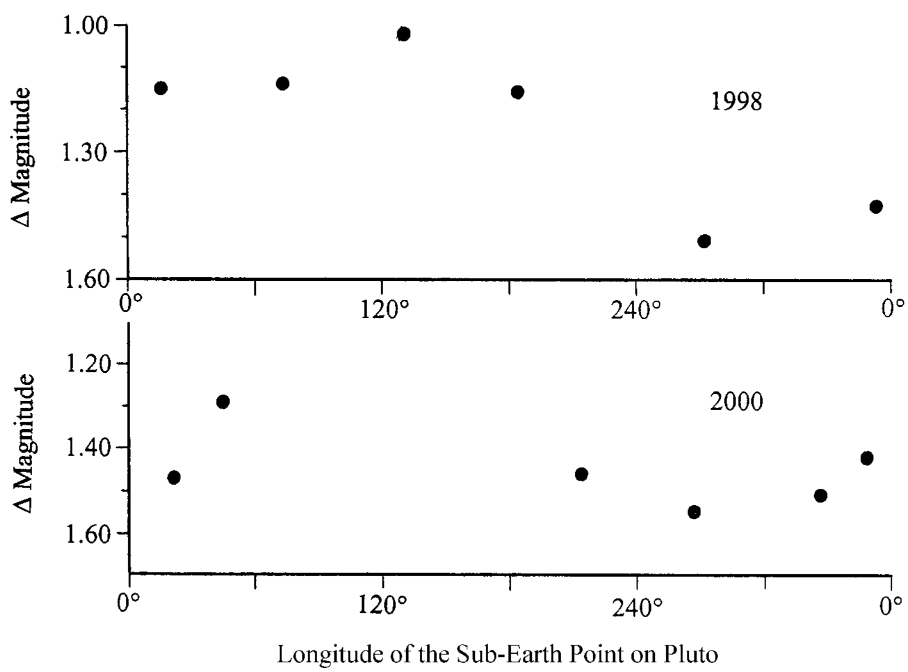

Figure 3: Plots of the difference in magnitude between the Pluto system and selected comparison stars in 1998 and 2000 versus the longitude of the sub-Earth point on Pluto.

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- **Lunar (Dembowski):** *The Lunar Observer, a* monthly newsletter, available online at the ALPO website homepage, http://www. lpl.arizona.edu/alpo/ . For hard copies, send a set of self-addressed stamped envelopes to Bill Dembowski (see address in listings section earlier in this section).
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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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ALPO Resources *(continued)*

ing kit and report form; send SASE with 55 cents in postage stamps to John Westfall.

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- **Minor Planets (Derald D. Nye):** *The Minor Planets Bulleti*n, 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 8564I-2309.
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Our Association is an international group of students of the Sun, Moon, planets, asteroids, meteors, and comets. Our goals are to stimulate, coordinate, and generally promote the study of these bodies using methods and instruments that are available within the communities of both amateur and professional astronomers. We hold a conference each summer, usually in conjunction with other astronomical groups.

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