The Strolling Astronomer

Journal of the Association of Lunar and Planetary Observers

Volume 42, Number 1, January 2000

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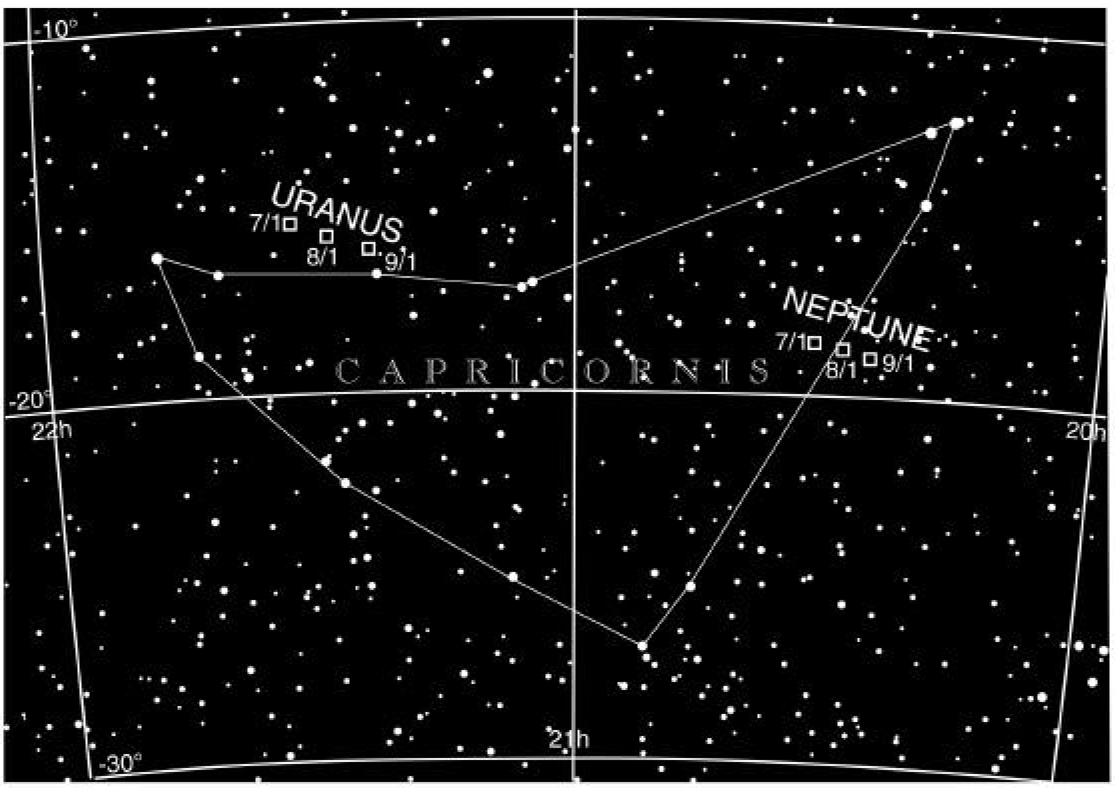
Inside . . .



During 1998, the appearance and brightness of Uranus and Neptune were monitored, the light curve of Pluto was measured and the relative brightness of Titania and Oberon was measured. See full report inside. Above is chart of Uranus and Neptune locations this summer.

Also . . . A new *Strolling Astronomer* debuts, apparition reports, drawing Mars and other tips and techniques, the ALPO honors noted lunar atlas author Antonín Rükl, and much more.

The Strolling Astronomer

Volume 42, No. 1, January 2000
This test issue was published in September 2000 and is a pdf (portable document format) version of the hardcopy issue published in June of this year.

The Strolling Astronomer (also called *JALPO*) is the official journal of the Association of Lunar and Planetary Observers (ALPO).

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

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

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Guest Column:
Ken Poshedly

"I'll give it a try." That's what I said a few months ago when Harry and I talked about me doing this sample issue. And I did. I tried using my own knowhow of publication design to improve on the great start put forth by Walter Haas and John Westfall.

What I came up with is my own slant on putting fresh life into the only publication of its type. Some of the things I've tried include:

- Creating a more standardized front portion of the magazine. For instance, while the comprehensive directory is at the back, a directory of the ALPO principle board and staff is to the left of this column.
- Putting important material about the ALPO up front, where it belongs, in an *ALPO Pages* section. While it's true that we want to, of course, publish our observational findings, I believe it's more important to first get across the news about the organization.
- Adding color. In this sample issue, I've experimented with colorizing the table boxes and story title boxes. I even used some color photos of Mr. Rukl's visit to the Peach State Star Gaze.
- Arranging the feature stories in a more logical order. For instance, I moved the Comet LINEAR story up and placed the less-timely or less time-dependent material towards the back.

None of these techniques are meant to reflect badly on John's hard work. I'm sure that he both loved and hated this job, as I am sure to. But whereas he seemed to have total control to the point of rewriting articles and generating graphs and charts, those are things I will not do. If the authors do not provide them, there will be none.

That doesn't mean I won't choose to spruce things up with graphics that I think will catch a reader's eye. After all, what good is an article if no one reads it?

I hope that whatever errors you find are minor and that the criticisms are few. If allowed to proceed, I wish to start off slowly with the standard four issues per year, and work up from there. But we'll see. We'll just wait and see.

The ALPO Pages

Errata

In the *Strolling Astronomer*, Vol. 41, No. 4, the Universal Times, or possibly the dates, of two illustrations in the article, "Observing the Moon: Mountains," are incorrect, as evidenced by the solar illuminations they exhibit.

Uunfortunately, we still do not know their correct UT times/dates. The first case is Figure 1 (p. 173), as brought to our attention by Walter Haas; its stated colongitude of 213°.5 is consistent with the UT date and time cited (1998 Nov 14, 10h10m UT), but the actual appearance is consistent with a colongitude near 180°.

The other case is Figure 4 (p. 175); the stated UT (1996 Aug 24, 02h06m UT) implies a colongitude of 030°.7, but the shadows of features are more consistent with a colongitude of about 015°.

We regret the error.

Organizational Announcements

ALPO Section Changes

New ALPO Comets Section Coordinator -- Don E. Machholz, who has served the ALPO as its comets section coordinator since 1988, and creator of the well-known "Comet Comments" column, has resigned his post due to personal reasons. Although his contributions will be sorely missed, we are fortunate in being able to fill his position with his colleague, Gary Kronk. His address is: 1117 Troy-O'Fallon Road, Troy, IL 62293; e-mail address kronk@amsmeteors.org .

Staff Address Changes--

- The postal address for Brian Cudnik, acting coordinator, Lunar Meteoritic Impacts Search, has changed his postal is now 5800 Hollister Rd., #1616, Houston, TX 77040.
- The new e-mail address for Robert Lunsford, coordinator of the Meteors Section, is now lunro.imo.usa@prodigy.net.
- The e-mail address of Julius L. Benton, Jr., ALPO executive director member, and coordinator of the Lunar, Venus and Saturn sections, is now: jlbaina@aol.com.
- The e-mail address of Mars section coordinator Dan Troiani is now dantroiani@earthlink.net.
- ALPO History section Acting Coordinator Thomas D. Dobbins and Acting Assistant Coordinator William Sheehan are both in the process of moving and thus currently have no postal addresses; the e-mail address for Mr. Dobbins is now r&d@organictech.com.
- The postal address of John E. Westfall, ALPO board member, editor, Mercury/Venus Transit coordinator and assistant Jupiter coordinator (Galilean Satellites), is now P.O. Box 2447, Antioch, CA 94531-2447.

ALPO Convention

Our 2000 Convention will be held at Ventura, California, July 19-22, meeting with the Astronomical League and several other organizations. The meeting will be hosted by the Ventura Astronomical Society. For further information, check the webpage: http://www.vcas.org/astrocon/ or send e-mail to astrocon2000@vcas.org.. The ALPO paper session is scheduled for all of Thursday, July 20, with a board meeting that evening. As of May 31, the convention tours were all almost sold out, the speaker slots about filled, but there was still room for the BBQ and the banquet. Those who wish to attend should delay no longer in registering!

Minor Planet Elmerreese

Pioneer ALPO member and Jupiter section recorder Elmer J. Reese has been honored by having Minor Planet 8377 (1992 SD1) named for him. This was done at the suggestion of of T. Sato, W.H. Haas, and I. Hirabayashi. The asteroid was discovered by K. Endate and K. Watanabe on 1992 Sept. 23 with a 25-cm f/2.6 Schmidt camera. For those who would like to seek this object, its Epoch 2000.0 orbital parameters are: T 1997 DEC 18.0, semimajor axis 2.5409325 AU, eccentricity 0.0960145, argument of perihelion 294°.50783, longitude of node 048°.19198, and inclination 9°.74647.

Generous Members

A gratifying number of our members contribute more than the required dues; the excess is of great help to our organization and may be tax-deductible.

"Sponsors" ($100 donations) currently include: Julius L. Benton, Leland A. Dolan, Phillip Glaser, Donald

C. Parker, James Phillips, Cecil C. Post, John F. Walsh, Matthew Will and Thomas R. Williams.

"Sustaining Members" ($50 donations) include: Klaus R. Brasch, William Dembowski, Richard D. Dietz, Richard R. Fink, David C. Grosvold, Walter H. Haas, Robert H. Hays, Daniel del Valle Hernandez, Mike Hood, H.W. Kelsey, David J. Lehman, Robert D. Lunsford, Michael A. Nicholas, Arthur K. Parizek, Jo‹o Porto, Timothy J. Robertson, Takeshi Sato, Mark L. Schmidt, Charles Shirk, Lee M. Smojver, Roger J. Venable and Gerald Watson.

The ALPO Historical Section: a Brief Overview

By: Richard W. Schmude, Jr., ALPO Remote Planets coordinator and acting assistant coordinator, ALPO Historical Section; and Gary L. Cameron, acting coordinator, ALPO Historical Section

The ALPO Historical Section was formed in 1996 (J.ALPO, 39, No. 2, Oct.,1996, p. 93) and is one of our newest sections. Its goal is to publish historical papers related to one of these three topics:

- History of the ALPO
- History of Solar System studies
- Evaluation of unpublished data for scientific purposes

Each of these areas is described below:

The ALPO was founded by Walter Haas in 1947 and thus already has an extensive history. Historical documents of interest include photographs of events connected with the ALPO, letters to and from members and oral and written documents pertaining to the organization. Documents related to such areas as telescope making or the history of amateur astronomy may also be of interest to the section coordinators.

The ALPO Historical Section welcomes historical documents, letters and photographs related to Solar System studies. Documents describing early observations of the f-Ring of Saturn or of the Great Red Spot on Jupiter, for example, are welcome. Short biographies of Solar System astronomers or historical documents related to famous telescopes, rocketry and photography would also be gratefully received.

The authors believe that there is a large amount of old published and unpublished data that could still yield useful scientific data. This provides an opportunity to publish relevant data from pre-existing observations. For example, one of the authors is planning to convert photoelectric magnitude measurements of Neptune made in the 1930s to the standard Johnson B and V system. In this way, photoelectric magnitude measurements made in the 1990s on the Johnson B and V system can be compared to measurements made six decades earlier.

In conclusion, the coordinator and assistant coordinator are very excited about the ALPO Historical Section and welcome correspondence from all interested parties.

ALPO Honors Antonín Rükl

Many years and books later, noted lunar and planetary author presented with lifetime ALPO membership

By Ken Poshedly

Antonin Rukl, whose *Atlas of the Moon* continues as perhaps the most popular work of its kind, was honored with a lifetime membership in the ALPO at the 7th annual *Peach State Star Gaze* on April 8. The award was presented by ALPO founder and director - emeritus Walter H. Haas. And it was Mr. Rükl's first appearance at an amateur observing event -- in the U.S. or elsewhere.

Also on hand for the presentation were ALPO staff Harry D. Jamieson, membership director and treasurer; Jukius Benton, observing coordinator of the Venus and Saturn sections and Lunar Selected Areas Program; Brian Cudnik, observing coordinator of the Lunar Meteoric Impact Search Program, and Ken Poshedly, ALPO publicist and founder of the *Peach State Star Gaze.*

Antonín Rükl autographs a copy of his book, *Atlas of the Moon*, at the Atlanta Astronomy Club table on the main observing field at the 7th annual *Peach State Star Gaze*. (*Photo by Carlos Flores, AAC*)

Besides the lunar atlas, his other works include poster-size wall-maps of the Moon and Mars, as well as books on the Moon, Mars, Venus and astronomy for beginners. He recently retired from his position as director of the Prague Planetarium (Czech Republic).

Mr. Rükl (second from left) following the presentation of a lifetime membership in the ALPO is flanked by Harry Jamieson (far left), then Walter Haas (center), Julius Benton, Brian Cudnik and Ken Poshedly. (*Atlanta Astronomy Club photo*)

Mr. Rükl and his wife, Sonja, were in the U.S. specifically for the PSSG sponsored each year by the Atlanta Astronomy Club.

The PSSG event, held at a state park about 40 miles southeast of Atlanta during a young crescent Moon weekend, provided a three-night venue for both lunar and deep sky observers, with considerable emphasis on promoting lunar observing. Almost 300 persons registered for the event.

Besides his three talks on lunar cartography, illustrated with slides and ALPO award, Mr. Rukl was also presented with a pin and certificate from the Astronomical League for "completing" that organization's observing list of lunar objects. All agreed that in reality, it was Mr. Rukl's work that helped so many others complete their own AL lunar list.

Other slide-and-talk presentations included:

- Walter Haas -- "Those Unnumbered Reports of Lunar Changes - Were They All Blunders?" A brief historical outline, a consideration of some basic concepts in lunar observations, and a number of examples of reported changes or unusual temporary appearances on the surface of the Moon.

- Julius Benton -- The ALPO Lunar Selected Areas Program.
- Brian Cudnik -- The ALPO Lunar Meteor Impact Search program.
- Phil Sacco (AAC member and extremely active lunar observer) -- The lighter side of lunar observing.
- Panel discussion with all of the above plus Harry Jamieson and AAC member and active lunar observer Phil Sacco taking questions from the audience on the value of continued Earth-based lunar observing.

Panel discussion on lunar observing with (left to right) Phil Sacco, Mr. Rükl, Brian Cudnik and Walter Haas. (*Photo by Ken Poshedly*)

Besides the talks and workshops, all were treated to fairly good skies plus a rare display of the aurora borealis -- hardly ever seen as far south as Atlanta -- and a pleasant grouping of the young crescent Moon and planets Mars, Jupiter and Saturn on the first night of the event.

This marks the first time a local astronomy club in the U.S. has brought in a speaker from outside the country. Next year, the Atlanta Astronomy Club will feature noted deep sky author Wil Tirion.

About Antonín Rükl

Mr. Rükl was born in Caslav, Czechoslovakia (now the Czech Republic), in 1932. In 1956, he graduated from the Czech Technical University, Faculty of Geodesy, branch geodetic astronomy. Then he joined the Institute of Geodesy in Prague as a staff member of the astronomical department.

Since 1960, Mr. Rükl has been working in the Prague Planetarium holding responsible functions, particularly, on merging the Planetarium with the Stefanik Observatory in Prague in 1979, becoming deputy director of the Observatory and Planetarium of Prague and the Head of Planetarium Prague.

Now retired since the end of 1999, Mr. Rükl still works at the Observatory and Planetarium of Prague. Mr. Rükl lives in Prague with his wife, Sonja. They have a daughter, Jane, and son, Mike.

Mr. Rükl is a prolific popularizer of astronomy, author of many audio-visual planetarium programs for the schools and general public, co-organizer of international planetarium conferences, and was vice-president of the International Planetarium Directors Conference (IPDC) from 1996 through 1999.

He is a skilled cartographer, illustrator, writer, author of great number of astronomical maps, atlases and pictorial publications which are translated into many languages. He authored several lunar maps and as well as the highly popular book, Atlas of the Moon, published in 1991. Today, it is available from Sky Publishing corporations.

Mr. Rükl himself designs and illustrates his own books. He has worked out the original drawing techniques of the lunar maps as well as the techniques of the photo-accurate drawing of celestial objects with airbrush. In recent years he has been preferentially using computer graphics.

Selected Cartographic Works of Antonín Rükl:

Maps of the Moon and Mars (Kartografia Praha, Scientifics, and others, since 1964 several different wall maps and other maps enclosed into publications, e.g., as the annex to the *Photographic Atlas of the Moon* by Z. Kopal et al.,Academic Press. N.Y. and London, 1965). New wall map of the Moon published 1999 in Prague.

Maps of Lunar Hemispheres (Reidel Publishing, Doordrecht, Holland, 1972)-- to this day a unique mapping of the Moon from six cardinal directions.

Atlas of the Moon (Aventinum Publishers, Prague 1991), probably the best known in the world of Rükl's cartographic works; published several times since 1991 in English, German, French, Japanese and Czech.

Other illustrated books and atlases:

Constellations (Artia, Prague 1971, later Aventinum Publishers, Prague), a popular pocket atlas published and distributed since the 1970s in many editions and in eleven languages. Recently, completely re-written, new illustrated and updated editions of this book, namely *Constellation Guidebook* (Aventinum for Sterling Publishing Co. Inc., New York, 1998; reprinted in April 1999), also in Czech, French, Italian and German in 1996-1998.

Moon, Mars and Venus (Artia, Prague 1979), a pocket atlas of the nearest celestial bodies of our solar system, edited in seven languages.

Welten, Sterne und Planeten (Artia, Prague 1979), also in English as *The Amateur Astronomer*, then *Stars and Planets etc.,* a popular richly illustrated survey of astronomy for the beginners.

Pictures from the Depth of the Universe (Artia, Prague, 1988, later Aventinum, Prague), published also in English as *The Hamlyn Encyclopedia of Stars and Planets* and in other languages - an atlas of the celestial objects with numerous astronomical maps.

ALPO Membership Dues and Advertising Rates

Founded by Walter Haas in 1947, the ALPO now has about 500 members. Our dues include a subscription to our quarterly journal, *The Strolling Astronomer*, (also called *JALPO*), and are $23 for one year ($40 for two years) for the United States, Canada, and Mexico; and $30 for one year ($54 for two years) for other countries. One-year Sustaining Memberships are $50; Sponsorships are $100. There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice.

Our advertising rates are $85 for a full-page display advertisement, $50 per half-page, and $35 per quarter-page. Classified advertisements are $10 per column-inch. There is a 10-percent discount for a three-time insertion on all advertising.
All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "ALPO" All cash or check dues payments should be sent directly to: ALPO Membership Secretary, P.O. Box 171302, Memphis, TN 38187-1302. When you write to our staff, please provide a stamped, self-addressed envelope. Note that the ALPO maintains a World-Wide Web homepage at http://www. lpl.arizona.edu/alpo/

Keeping Your Membership Current.--The top line of your JALPO mailing label gives the volume and issue number when your membership will expire (e.g., "42.1" means Vol. 42, No. 1). We also include a first renewal notice in that issue, and a final notice in the next one. Please let the membership secretary know if your address changes. Dues payments should be made directly to the membership secretary.

Charles Morgan Cyrus--Personal Notes

By Carole J. Budosh

[Editor's Note: Our readers will recall Walter Haas' note, "In Memoriam: Charles M. Cyrus", in our last previous issue (J.ALPO, 41, No. 4, p. 172). Since then, we received a letter from his daughter, Carole J. Budosh, which is quoted in part below. We also include here a photograph of Charles Cyrus.]

Dad was born Charles Morgan Cyrus on January 5, 1920 in Lynchburg, Virginia, the youngest of eight children. He grew up in Virginia, studying art in high school and working at the Allen-Morrison Sign Company until he was drafted on November 14, 1942. He served in the Signal Corps during World War II, but was not sent overseas.

Charles Cyrus (left) with ALPO Founder Walter Haas at the ALPO-Astronomical League Convention in Baltimore, Maryland in 1986.

During his military service, he met my mother, Della Kazlauski, marrying her in Missouri on January 13, 1945. After his discharge on February 11, 1946, they moved to Baltimore where they lived with my mother's parents. They had two children: Carole, born October 6, 1948 and Barbara, born July 11, 1958. Dad went to work for Bethlehem Steel Company as a marine draftsman on October 11, 1951, working there until he retired on February 28, 1982.

Dad had several hobbies. He enjoyed photography and had his own darkroom equipment. His interests later turned to astronomy. He had several telescopes, and polished his own mirrors. I remember my Mom complaining about the odor of pine tar and the red polish around our home. When he had his telescope out in our backyard, he would often end up with the neighborhood children standing in line to have a look. He always took the time to explain what he was looking at, and let each one have a turn to see. He also belonged to an astronomy club; besides meetings, they had "star parties" at local schools or parks where novices could go and take a look at the stars. He continued this until a few years ago.

My mom passed away in August, 1985, after which Dad started to paint again, first with oils and then with water colors. He attended a few formal classes at the Schuler School of Fine Arts in Baltimore. After that, he became a member of the Maryland Art League as well as the Catonsville Senior Center. He proved to be very talented. His works were often on display in different local public buildings, and he usually sold at least one painting as a result of each showing.

At the time of his death, on October 26, 1999, he was survived by a brother, Royal, and a sister Irene, whom he had just visited in Virginia before his car accident. He has four grandchildren: John M. (28) and Brian C. Budosh (23); and Michael S. (16) and Kristin A. Abrams (6). He has no great-grandchildren.

50 Years Ago in *The Strolling Astronomer:* May 1, 1950 (Vol. 4, No. 5, pp 8-9)

"Some Curious Objects -- Meteoritic Perhaps"

Writing on April 9, 1950, Mr. Tsuneo Saheki of Osaka, Japan, tells us that "an amateur in Tokyo observed a very brilliant spot appearing on the south-southwest limb of Mars for 2-3 seconds on March 24, 11h 45m, with his 15 cm. reflector, 146X." Unfortunately, no one else was observing Mars at the time as far as he knows. Mr. Saheki uses west to mean to the right in a simply inverted view with south at the top. The date and time are by U.T.

Since the central meridian of Mars at the time was 196°, the brilliant spot must have been at a high southern latitude near longitude 286°- probably over Hellas. Two possible interpretations of such a transient brilliant spot are that it was either the flare caused by the impact on the surface of Mars of a giant meteorite or a fireball of extraordinary brilliance in the atmosphere of the planet. The distance of the planet on March 24 was about 60,000,000 miles; it follows that a luminous object was then 28.9 stellar magnitudes fainter at the distance of Mars than at a distance of 100 miles.

This difference may be compatible with a meteoritical interpretation, for there is evidence that terrestrial fireballs and meteoritic impact-flares are very rarely as bright as the sun, or of stellar magnitude -27. An object that bright at a distance of 100 miles would be of stellar magnitude 2 at a distance of 60,000,000 miles and would thus appear to an observer to be "a very brilliant spot."

On the other side of the world Mr. R. Rigollet has communicated an observation of a temporary, stationary, bright spot on the moon by Mr. Albert Hestin, an ALPO member at Acyen-Multien (Oise), France. Mr. Hestin was observing with a 31 cm. (12 in.) reflector at 65X on March 26, 1950, at 18h 56m, U.T., when his attention was caught by a bright spot not in the lunar region that he was examining.

"The brightness of this glow having immediately attracted his attention, he had time to turn his gaze toward it and to look at it directly for a fraction of a second before it disappeared." (This quoted sentence was translated by the editor.)

The sky was very clear, and the seeing was fairly good. Mr. Hestin estimated the stellar magnitude at 6 and the angular diameter at 10". The spot was diffuse and nebulous and was yellowish in color.

The moon being near the first quarter, the spot appeared on the earthshine in the vicinity of Landsberg [Lansberg]; the lunar coordinates were about 40° East [40° West in the modern IAU system], 4° North. Mr. Hestin "is entirely affirmative upon the objective reality of the object he saw." The appearance and disappearance were rapid but were certainly not instantaneous.

It appears to the editor rather unlikely that a lunar meteor (in a very rare lunar atmosphere, of course) would have an angular diameter of 10". It is more probable, he thinks, that this object was a meteoritic impact-flare, with irradiation perhaps greatly increasing the apparent size.

There is also a curious resemblance in appearance to eighteenth and nineteenth century observations of temporary bright spots on the earthlit moon by Herschel and Schroeter, among others. However, these spots of the past endured for a number of minutes, according to the observers, while Hestin's spot lasted for a few seconds or less.

[A final paragraph, interpreting a report of a dark object seen crossing the Moon, has been omitted here.]

The Coming Apparition of Comet LINEAR (C/1999 S4)

By: Don Machholz, former coordinator, ALPO Comets Section

Discovery

This summer a new comet should be visible in our northern sky. Named Comet LINEAR (C/1999 S4), it was discovered on 1999 Sept 27, while still 400 million miles from Earth. The discovery equipment was a U.S.Air Force-sponsored 1-meter telescope, supplied with a large CCD chip to capture the images. Those images are then input into a program that subtracts all the known objects. What remains are the new objects: asteroids and comets. C/1999 S4 was at first suspected to be a new asteroid, but further investigation revealed that it had a coma and short tail. Early brightness estimates placed the nucleus at magnitude +17.

Orbit

This comet will get closer to the Sun than does Earth, about 0.77 AU [1 AU is the mean Earth-Sun distance; 149,597,870 km]. This occurs on 2000 July 26. [The closest approach to Earth, at 0.37 AU, is on 2000 July 22.] Its orbit is retrograde, meaning it circles the Sun in the opposite direction as the Earth. The orbital elements, calculated by Dr. Brian Marsden of the International Astronomical Union (IAU) from 181 observations between 1999 Sept 27 and Oct 25, are from *Minor Planet Circular 36213* (Equinox 2000.0):

Perihelion date: 2000 July 26.3979 UT
Perihelion distance: 0.766182 AU
Argument of Perihelion: 150°.9998
Ascending Node: 083°.1500
Inclination: 149°.3473
Eccentricity: 1.0

By graphing the comet's distance to the Sun, we see how the comet approaches and recedes from the Sun. Meanwhile, the Earth's orbit around the Sun varies the comet-earth distance. These variations are plotted in Figure 1.

Brightness

On the assumption that the absolute magnitude is +7.0, and the rate of brightening (n) is 4.0, the apparent magnitude of the comet would vary as shown in Figure 2.

Observing Prospects

Comet LINEAR will be behind the Sun in late April 2000. Before that, some amateurs may be able to find

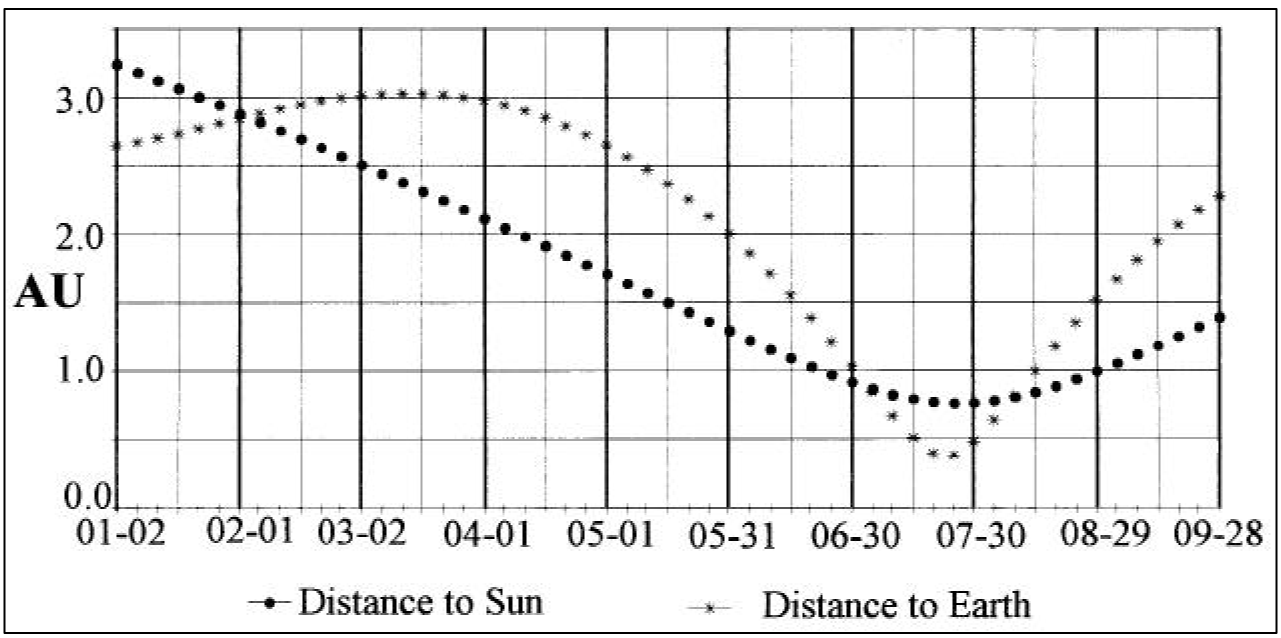

Figure 1: Distance of Comet LINEAR from Sun and Earth, 2000 Jan. 02 - Sept. 28.

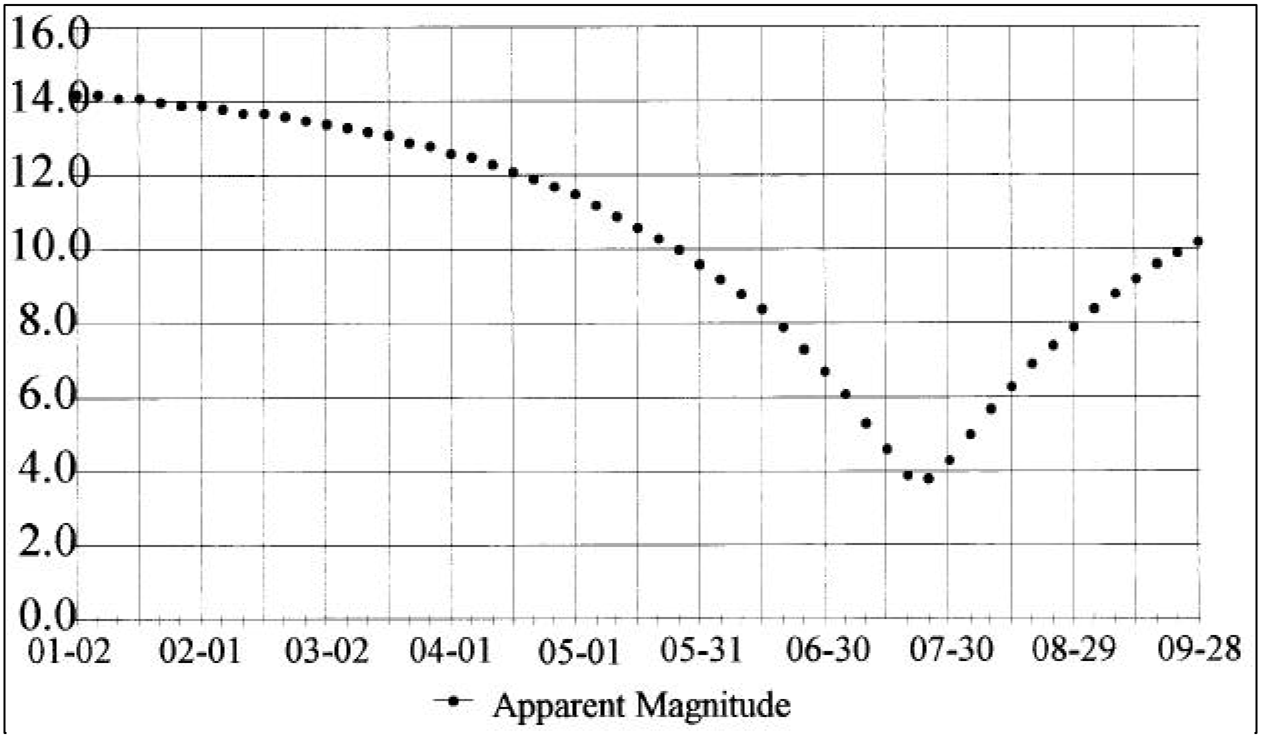

Figure 2: Predicted visual magnitude of Comet LINEAR, 2000 Jan. 02 - Sept. 28.

it in the evening sky as it brightens to magnitude +12. By late May, the comet emerges into our morning sky when, if it lives up to expectations, it will be roughly magnitude +10.0. The comet will then move slowly against the background stars for the next month. But its northward movement, later succeeding twilights and the diurnal eastward motion of the Sun will cause the comet to be higher in the sky each morning. In Figure 3, we see the scene awaiting astronomers on 2000 June 01.

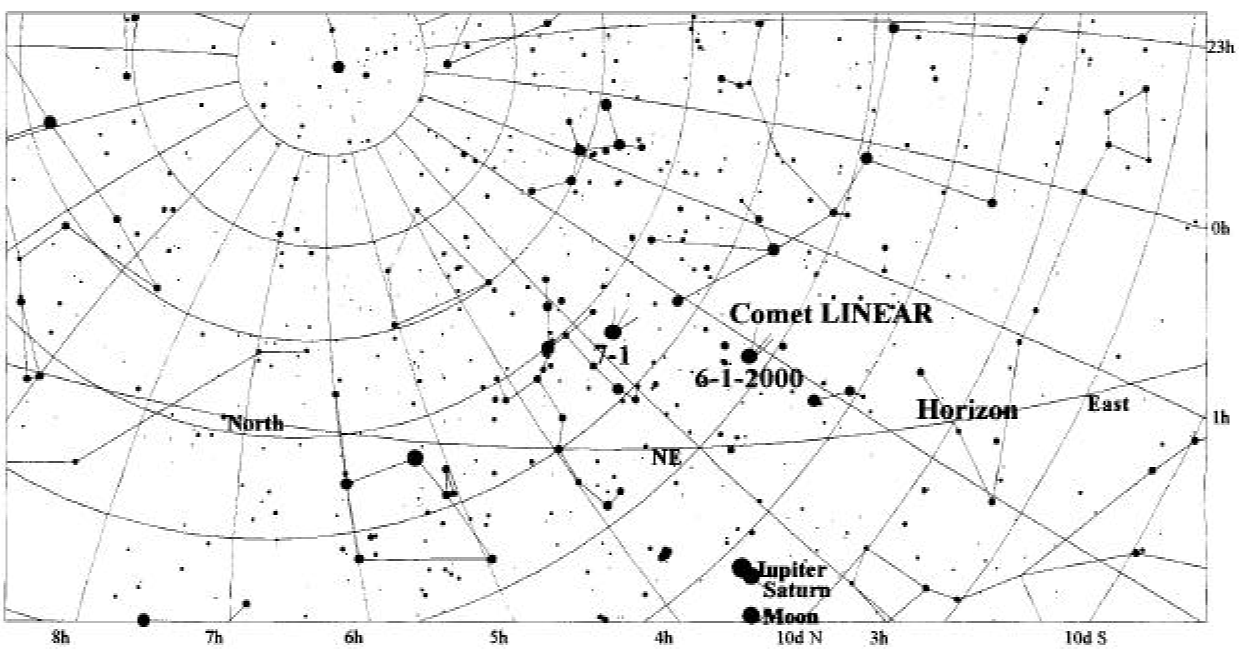

Figure 3: Position of Comet LINEAR, 2000 June 01; morning horizon for 40° N latitude.

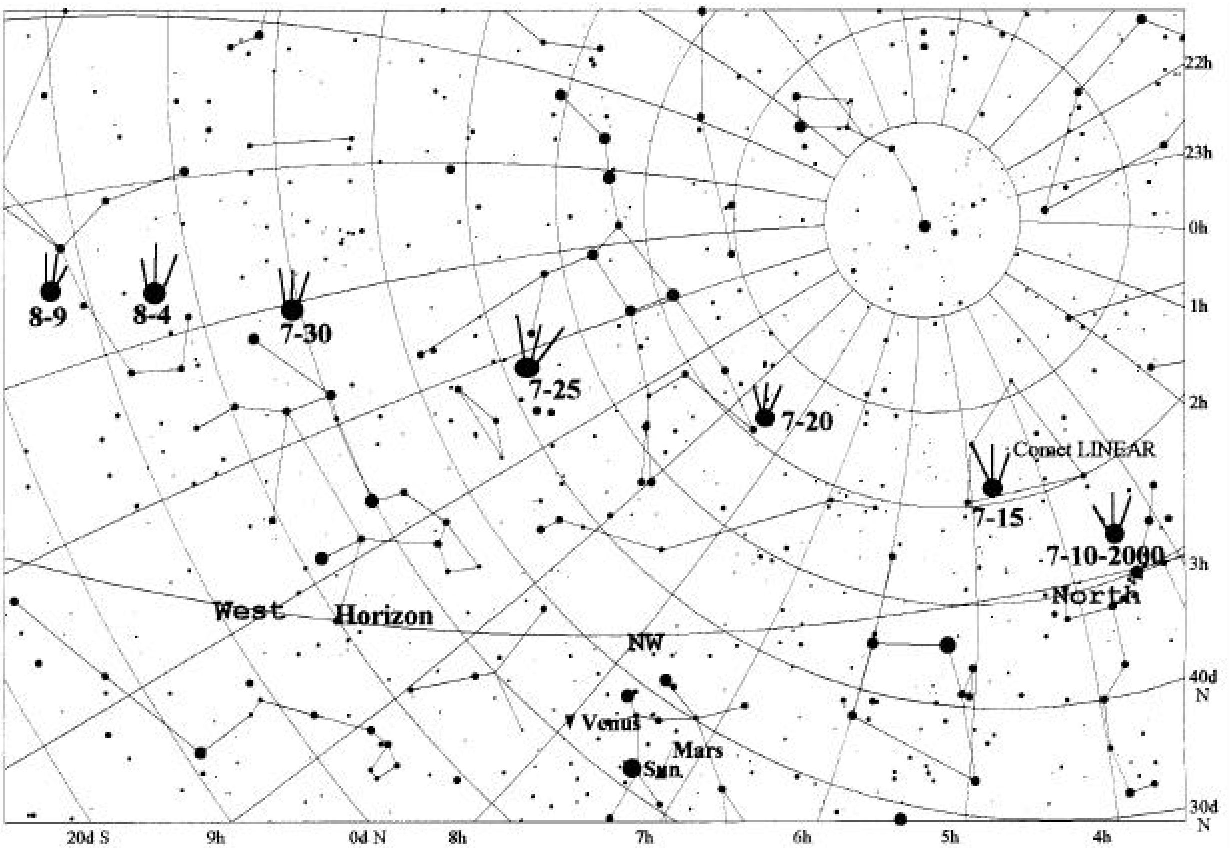

Figure 4: Comet LINEAR in the evening sky, 2000 July 10 - Aug. 09; hmorizon for 15 July, 40°N.

Those who continue observing the comet in the morning should see it not only higher in the sky, but also brightening by about 2.5 magnitudes during June and by two more magnitudes over the following two weeks. It will continue moving northward, but its eastward motion will drag it into the evening sky. During early July, the comet will no longer climb higher each morning, even though it will rise at about the same time. At this time southern hemisphere observers will lose the comet.

On 2000 July 19, Comet LINEAR will pass north of the Sun and into the evening sky. Figure 5 shows that it will be visible just above the northern horizon after sunset by 2000 July 10. For those north of about 35° North latitude, the comet will be above the horizon all night long.

The comet should be at its brightest while it is in the evening sky during the last part of July it. Then, as it continues to move southward, it will pull away from both the Sun and Earth and become fainter. For observers in the mid-northern latitudes, Comet LINEAR will be lost to the evening twilight in mid-August while it is still magnitude +6-7. Southern-hemisphere observers will be able to observe the comet until it enters the Sun's glare in late September. When it emerges into the dark sky in early December, it should be at magnitude +12-13.

Conclusions

No one yet knows how well this comet will perform The best way to find out is to get out there and look at it for yourself. Share it with others. If you have observations or photographs of the comet, you should send them to the new ALPO Comets Coordinator, Gary Kronk, at 1117 Troy-O'Fallon Rd., Troy, IL 62294; or e-mail him at kronk@amsmeteors.org .

No one yet knows how well this comet will perform The best way to find out is to get out there and look at it for yourself. Share it with others.

With Hopes of an ALPO in Our Future . . .

Some Recollections of Youth, the ALPO, and Observations of Saturn

By: Julius L. Benton, Jr., coordinator, ALPO Saturn Section

Abstract

The writer's roots in observational astronomy and eventual involvement in the work of the ALPO are discussed, with emphasis on the stimulus that the ALPO provided for his long-term involvement in lunar and planetary astronomy. Personal interpretations of accomplishments by ALPO Saturn observers during the first 50 years of the existence of the organization are discussed. The linkage between amateur and professional work is cited, and recommendations for the continuance and refinement of observational programs, methods, and techniques are presented. Systematic and simultaneous observations are stressed, and suggestions are given for encouraging youth to participate in ALPO educational and observational endeavors as a foundation for the future of the organization.

Introduction

With the new millennium quickly approaching, and in keeping with ASTROCON Ô99's theme of "A Thousand Years of Stars and Space," it is perhaps appropriate to discuss some my personal foundations in observational astronomy and how I eventually got involved in the work of the Association of Lunar and Planetary Observers, directing Saturn observing programs for almost thirty years. It may also be fitting to reflect upon some of the accomplishments of amateur Saturn observers since 1947, the year that the ALPO was founded by Walter Haas, with suggestions for continued studies of the planet and its satellites in 2000 and beyond.

Astronomical Awakenings

I fondly recollect my excitement on that special Christmas morning in 1960, just a month before my 10th birthday, when I awoke to find my first telescope set up "under" the tree--a new Unitron 2.4-inch refractor! As fate would have it, skies were overcast for nearly a week following that eventful morning, but those circumstances afforded ample time for me to read the instruction manuals that came with the instrument and to learn how I could use setting-circles and a clock drive to locate and follow the stars. That first clear night finally arrived, but no words could adequately describe the overwhelming joy of my first celestial adventures with this small telescope. Armed with excellent star maps published in *Sky & Telescope* magazine and Norton's Star Atlas, I whiled away countless hours over the ensuing years learning the constellations and tracking down every celestial object within the grasp of my tiny Unitron. I was also fortunate, for most of my childhood years, to be blessed with a dark, unobstructed observing site from which to pursue my celestial explorations.

By the time I entered high school, I had already become quite familiar with the night sky, and it was not long before l was bitten by the "bug" to move up to a larger aperture. Working part-time jobs, I raised enough funds to purchase a Unitron 4-inch photo-equatorial refractor. Almost immediately, I began taking advantage of its increased resolution and light-grasp to hunt down new, fainter deep-sky objects or to get better views of many of my favorite ones. After finding and sketching virtually all the Messier objects and splitting numerous double stars, my interests shifted to observations of the Moon and the brighter planets. The wealth of lunar detail l could see with the 4-inch Unitron thoroughly fascinated me, and I enjoyed making my own drawings of interesting lunar features such as Alphonsus, Aristarchus, Clavius, Coper-nicus, and Plato as they changed appearance at different phases of the Moon. Even though I had observed all of the planets except Pluto, Venus and Saturn eventually became my enduring favorites. Continuing the habit I acquired with lunar studies, I kept careful records of my planetary observations in a logbook for future reference.

My passion for planetary astronomy followed me into my college years, although I wound up majoring in physics and environmental science due the scarcity of potential employment opportunities in astronomy. After completing undergraduate studies in 1969, my interest in lunar and planetary astronomy had become a virtual obsession, ushered in by the unprecedented events of July 20, 1969 when Apollo 11 touched down on the Moon in the Sea of Tranquillity. The following year l attended my first ALPO convention, where I met Walter Haas for the first time, and I discussed with him my interest in contributing lunar and planetary observations. His enthusiasm, encouragement, and guidance helped stimulate my involvement in ALPO activities. But, for a few more years, the rigors of graduate school occupied most of my time as I finished work on advanced degrees and began a collegiate teaching career, Even so, I somehow managed to set aside a few hours a week to spend time at the telescope and get more acquainted with others in the ALPO who shared similar interests.

The Association of Lunar and Planetary Observers

The congenial, informal atmosphere of the ALPO proved to be refreshing and wonderfully captivating, and I soon developed a real appreciation for the great diversity of backgrounds and experience of the small, but closeknit, membership. Sharing many different philosophical and scientific viewpoints about instrumentation and observing has been very meaningful over the years. I found serious observing endeavors to be synonymous with fun, and l welcomed the opportunity to contribute my own observations to a collective pool of data that had the potential for enhancing our knowledge about the Solar System. Through an active exchange of information and ideas, many individuals have improved as observers, including myself. Also, I had not been a member of the ALPO very long before I discovered that *The Strolling Astronomer* (now also called the *Journal of the Association of Lunar and Planetary Observers*) and the information contained within its pages seldom existed elsewhere. This publication has helped establish and preserve a vital link between the amateur and professional communities. Annual conventions, often held jointly with the Astronomical League and other national and international groups, have always been enjoyable events as well as intellectually stimulating gatherings. I can attribute many lasting friendships to such meetings.

During the early 1970s, I was appointed Recorder (now “Coordinator”) of the ALPO Saturn, Venus and Lunar Sections. I valued the confidence placed in me by Walter Haas and fellow staff members in heading up these posts. Throughout my nearly thirty years as a Section Coordinator for the ALPO, the guiding principle established back in 1947 continues to be my principal focus: to encourage and coordinate regular, systematic investigations of the principal planets and other constituents of our Solar System with instrumentation normally available to amateur astronomers.

We have all witnessed the space program ushering in enormous progress in professional lunar and planetary astronomy, transforming our nearest celestial neighbors from virtually unknown and inaccessible objects into much more familiar worlds. Such advances might tempt one to assume that the work of amateur astronomers has been relegated to insignificance from Earth’s limited vantage point in space. Of course, the lunar explorations by the Apollo astronauts or the close surveillance of planets and satellites by orbiting or impacting spacecraft are clearly beyond the domain of the Earth-based amateur astronomer. Yet, there are still many areas of lunar and planetary observing that are ideal for the amateur astronomer, fields that can still be pursued without any immediate threat of obsolescence by the onslaught of imposing professional equipment. Also, in recognition of the excellent scientific work some amateur astronomers have done over the years, members of the professional community have solicited amateur participation in specialized projects, such as observations involving the Hubble Space Telescope. ALPO observers have also been involved in NASA programs such as the International Ashen Light Patrol of the Pioneer Venus Orbiter mission and the Lunar Prospector mission. Unlike most professionals, amateurs still enjoy the freedom of studying Solar System objects of their choice for extended periods. Constant monitoring of surfaces and atmospheres of moons and planets by diligent observers increases the likelihood of recording important features and phenomena by means of drawings, photographs, and CCD images.

So, the amateur astronomer's greatest potential for making useful contributions to planetary science remains a systematic, long-term, and simultaneous monitoring of the Sun, Moon, principal planets, satellites, comets, and meteors at wavelengths of light to which the eye has greatest sensitivity. ALPO archives include numerous instances where concentrated efforts by amateurs, when careful records were kept and data subsequently analyzed, helped improve our understanding of lingering mysteries about our Solar System. An enduring advantage of the visual observer is his unique ability to perceive, at intermittent moments of exceptional seeing, delicate, ill-defined detail that often eludes photography or other methods of imaging from Earth.

As mentioned earlier, professional astronomers, in trying to resolve some nagging observational dilemma by relying solely on existing spacecraft photography, have enlisted the services of amateur astronomers. Consider our Moon, for example. By fortuitous improper positioning of spacecraft cameras or because of unfavorable solar illumination, optimum views may not have been afforded of certain lunar features or regions. Fortunately, amateur observers were able to offer assistance by monitoring a specific region of the Moon under the conditions sought by the professional specialist. In some cases, the relevant data already existed in ALPO observational records, which demonstrates and emphasizes the critical importance of keeping long-term, reliable records. Such cooperative efforts clearly show how meaningful, and sometimes vital, amateur observations can be.

ALPO Observations of Saturn

Speaking perhaps best from my own perspective as ALPO Saturn Coordinator, it may be worthwhile to consider some of the results of amateur studies over the years that have helped shape our understanding of Saturn as a planet, namely:

1. From chiefly visual observations, we have learned that distinct belts and zones are not just occasionally seen on Saturn's Globe.

2. Faint, delicate details are more frequently seen within the belts and zones of Saturn's Globe, as well as in specific Ring components, if proper observational methods are used, especially employing color filters or variable-density polarizers.

3. Cassini's and Encke's Divisions are not the only such features seen in the Rings of Saturn, and confirmation of several "intensity minima" in the Rings was accomplished prior to the Voyager missions.

4. Amateur visual observations have shown that Ring C can be viewed at the ansae as well as in front of the Globe of Saturn with small to moderate apertures.

5. Observations of numerous dark spots or festoons, plus conspicuous white spots, have been accumulated. Most of these have emerged in the equatorial latitudes of Saturn's Globe, but they are not necessarily limited to those regions. Also, several prominent white spot outbreaks have suggested a recurring pattern over many years.

6. Variability has been noticed in the rotation rate of the SEB and NEB through observations of long-enduring spots.

7. Over a Saturnian year (equivalent to 29.5 terrestrial years), subtle variations have been detected in belt and zone intensities that may be linked to a subtle, but definite seasonal effect.

8. Shadow intensity anomalies have been observed on quite a few occasions.

9. Reasonably good confirmation of the very tenuous, elusive Ring E (formerly known in ALPO literature as Ring D') exterior to Ring A occurred prior to the Voyager flybys.

10. Identification of a remarkable series of dusky radial "spokes" in Ring B (and sometimes suspected in Ring A), occurred prior to the views by Voyager.

I am confident that, using traditional as well as modern equipment and methods, ALPO observers will continue to enhance our knowledge of Saturn and the other members of our Solar System. Our challenge for the future as observers is to continually examine, criticize, refine, and develop our methods and techniques to the point where our work will remain supportive and useful to the professional scientific community. Our endeavors must also be organized in such a way that we can continue to attract and maintain a good team of skillful observers.

Widely-spaced observations or those that are poorly planned are of increasingly limited value, and the importance of systematic observations by many individuals, all using standardized methods, cannot be emphasized strongly enough. Observations should begin early in an observing season after a planet has just emerged from the pre-dawn solar glare and continue until the planet reaches conjunction with the Sun. Our goal must be to achieve a high incidence of simultaneous observations of variable lunar and planetary phenomena to confirm results and increase objectivity in visual data. Simultaneous observations, by definition, are independent, systematic studies of Solar System objects using identical methods, similar equipment, and standardized reporting techniques, all taking place at the same time on a given date of observation. Instrumentation should conform to specific criteria, and telescopes should be well-adjusted, similarly outfitted, and of the highest optical quality possible. Simultaneous observations help visual observers understand what detail on a planet is real or illusory, and although good simultaneous visual work is useful in the form of drawings and descriptive reports, photographic, CCD, or video imaging should be added to the mix. The introduction and increased availability of CCD cameras at fairly reasonable prices has allowed more efficient light detection than is possible with photographic film, and CCDs generate digital information that can be manipulated by image processors. The enormous dynamic range of CCDs and their high sensitivity to visual and near-infrared wavelengths make them a valuable tool in simultaneous lunar and planetary observations.

Although considerable information on observing Saturn can be found in *The Saturn Handbook*, it is worthwhile here to list some of the current observational pursuits by the ALPO observers:

1. Visual numerical relative intensity estimates of Saturn's belts, zones, and Ring components.
2. Full-disk drawings and sectional sketches of Globe and Ring phenomena. To assist observers in making drawings, the ALPO Saturn Section furnishes via mail or on the website templates with the correct Globe oblateness and Ring geometry. All drawings submitted for publication must be originals, not xerox copies.
3. 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). Saturnian CM longitudes will soon be available on the ALPO website.
4. Latitude estimates or filar micrometer measurements of belts and zones on the Globe of Saturn.
5. Colorimetry and absolute color estimates of Globe and Ring features.
6. Observation of "intensity minima" in the Rings (in addition to observations of Cassini's and Encke's Divisions).
7. Observational monitoring of the bicolored aspect of the Rings of Saturn.
8. Observations of stellar occultations by Saturn's Rings (ephemerides are published in various periodicals, the Saturn newsletter, and the website).
9. Specialized observations of Saturn during edgewise Ring presentations in addition to routine studies.
10. Visual observations and magnitude estimates of the satellites of Saturn.
11. Routine photography, CCD imaging, photoelectric photometry, and videography of Saturn and its Ring system (current images appear on the ALPO website).
12. Simultaneous observations of Saturn.

The 2000-2001 Apparition of Saturn is now under way [see note at end. Ed.], and members of the ALPO Saturn Section have already resumed their routine studies of the planet. We are always eager to enlist new observers, and anyone interested in our programs should contact this writer for information on how to get started. To aid in planning, Table 1, gives Universal Times for geocentric phenomena for Saturn during the 2000-2001 Apparition.

The Future

The foregoing discussion has been chiefly derived from personal reflections about the ALPO's past, a bit of philosophy gleaned from my experience as Saturn Coordinator for nearly three decades, and an overview of current Saturn observing programs. Much of what I have said also pertains to amateur observational astronomy as a whole, and I now offer the following concluding remarks about the future:

Table 1: Geocentric Phenomena in UT for the 2000-2001 Apparition of Saturn

Conjunction	2000 May 10d 29h UT
Opposition	2000 Nov 19 13
Conjunction	2001 May 25 13

Data for Opposition

Constellation	Taurus
Declination	+17°.3
Stellar magnitude	-0.4
Equatorial diameter (globe)	20°.43
Polar diameter (globe)	18".7
Major axis (rings)	46°.37
Minir axis (rings)	18".55
B	-23°.59
B'	-23°.83

NOTES

B is the saturnicentric latitude of the Earth refered to the plane of the rings; negative (-) when south (i.e., when the visible surface of the rings is the southern face).

B' is the saturnicentric latitude of the Sun refered to the ring plane; negative (-) when south (i.e., when the southern face of the rings is illuminated by the Sun)

1. I cannot emphasize enough the need for increased participation of youthful members in the ALPO observing programs, as well as in activities of astronomical societies on the local level. If our organizations and programs are to endure well into the next Millennium, we have little choice about this.

2. Experienced observers should make it a point to urge as many young people as possible to get "turned on" to astronomy by taking at least one youngster "under their wing" and developing that person as an observer. For example, one of the lasting accomplishments of the ALPO and the Astronomical League has been to provide challenging projects and guidance for young science enthusiasts, some of whom have gone on to become professional astronomers or scientists in other disciplines. For this to continue, we cannot wait for youth to come to us. We must reach out to our community science centers, our middle schools and high schools, our local PTAs, our colleges and universities, and our state and national parks, and take an active role in promoting observational astronomy as an enjoyable, worthwhile pastime.

3. No matter where our observational pursuits lead us, I sincerely hope that none of us becomes so consumed by zeal to produce scientifically useful data that we lose sight of the fact that our interest in astronomy is ultimately derived from a love and fascination for the night sky. We should all take a few moments away from organized observing programs to simply appreciate the exquisite beauty of the night sky. Relaxation and fun should remain an ingredient in all of our pursuits.

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[Note: The preceding paper was delivered at the 1999 ALPO Convention, held in conjunction with the ASTROCON Meeting of the Astronomical League in Cheney, Washington. At that time, Dr. Benton referred to the ongoing 1999-2000 Appari-tion of Saturn. Using the 2000 and 2001 editions of the Astronomical Almanac, the editor has updated that portion of this paper to refer to the now-ongoing 2000-2001 Apparition of Saturn.]

Drawing Mars

By: Jeffrey D. Beish, assistant coordinator, ALPO Mars Section

"To be able to acquire new knowledge while reviewing the old qualifies one as an instructor of men." Confucius

Introduction

A systematic, nightly visual observational program, accompanied with disk drawings and related notes, gives useful information about the physical condition of Mars. One can record the polar regions, meteorological phenomena, and physical conditions and colors of the surface features, all of which greatly aid in the cognizance, interpretation, and analysis of photographs and CCD images of the planet.

The frequently expressed statement "visual observation is only a subjective method" is a cliché used by some astronomers, indicating that photographs or CCD images are the only valid scientific method to record conditions on a planet. However, if one takes time to think about this, he or she should realize that that same objective photograph, in its final analysis, is interpreted by the subjective eye and subjective mind of an astronomer.

Even at its best, Mars is challenging to observe. The disk is tiny and its markings are blurred by the Earth's atmosphere. A telescope for planetary work should provide sharp images with the highest possible contrast. A long-focus refractor is usually considered the best, followed by a long-focus Newtonian or Cassegrain reflector. Telescopes with large central obstructions do less well. [Editor's Note: With the high magnifications often used, a steady clock-driven equatorial mounting is almost essential.]

The remainder of this article summarizes some of the more important aspects of observing the Red Planet.

Observing the Martian Disk

Mars is one of the more difficult celestial objects to study for several reasons. The apparent angular diameter of Mars is small, being only 14 to 25 arc-seconds -- even at opposition. For comparison, Jupiter has an apparent disk as large as 50 arc-seconds. When novice observers take their first telescopic view of Mars, they usually see only a bobbing, too-bright, orange globe with perhaps a white patch at one end. The untrained eye requires several nights of patient observing before the low-contrast features become evident. A yellow or orange color filter, or a neutral-density filter, dims the bright image and aids in reducing the irradiation within the observer's eye, thus helping to detect the pale features on the Martian disk.

After several nights of practice using 250X to 300X magnification eyepieces, the observer, referring to a Mars chart, will become familiar with the major Martian surface features. Even the most experienced planetary astronomer requires about two or three weeks of systematic observing at the beginning of each apparition before the finest details become evident on the glowing disk of Mars. So be patient, and practice drawing the larger features which are seen each night.

Given a night of excellent "astronomical seeing," when Mars is steady and sharp at the limb, smaller details will suddenly pop out around the larger features as they are drawn. Employ a shorter focal-length ocular or a Barlow lens, and increase magnification to the maximum that your seeing and telescope aperture will allow. Use up to 75X per inch of telescope aperture as a practical rule, especially if your telescope's optics are of high quality.

Note each small feature and carefully place it in its proper position relative to the nearest large feature. Check and sharpen the optical focus at regular intervals, as air parcels pass overhead or temperature changes in the telescope move the focal plane. The use of color filters will improve the quality of "astronomical seeing" in most cases, and will increase contrasts among Martian features. The telescopic image will usually be fuzzy, and it will be impossible to obtain a sharp focus when observations are made through the high-altitude jet stream. Check your current television weather map for the location and movement of the jet stream before observation. [Editor's Note: Everything else being equal, the seeing improves the higher an object is above the observer's horizon; i.e., near the celestial meridian if possible.]

Refer to Figure 1 to identify the following:

The Central Meridian (abbreviated as "CM") is an imaginary line passing through the planetary poles of rotation and bisecting the planetary disk. This line is used to define the areographic longitude range that is present on the disk during an observing session.

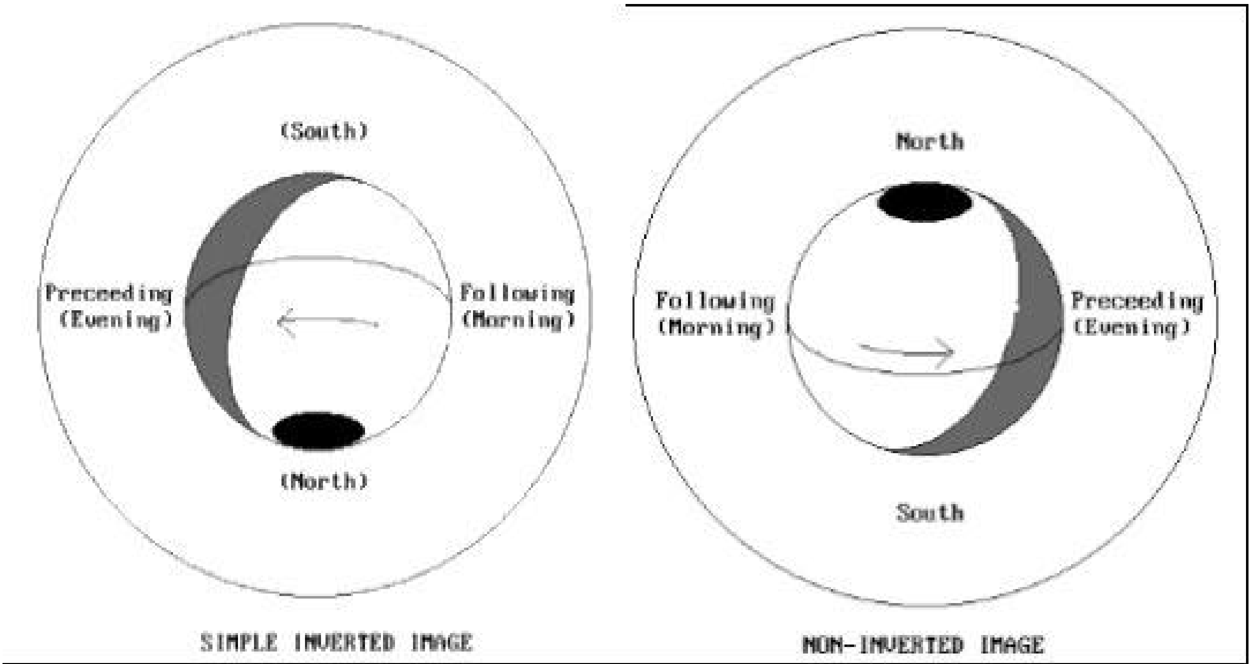

Figure 1: Telescopic views of a planet. Left: Orientation of the telescopic disk in a simply inverting telescope when near the celestial meridian as seen from the Northern Hemisphere (without a star diagonal; see text). Right: Orientation of the disk in a non-inverting telescope. Using a star diagonal will laterally reverse each view. Note northern axial tilt and the nomenclature used by planetary observers, as explained in the text.

The CM is independent of any phase which may be present -- if Mars presents a gibbous phase the CM will appear to be off center. The CM value is the areographic longitude in degrees which is on the central meridian of the disk as seen from Earth at a given Universal Time (UT). A fast adjustment to the UT of observation can be made by adding 0°.24/min., or 14°.6/hr., to the daily CM value for 0 hours UT as listed in Mars ephemerides.

The Terminator (phase defect) is the line where daylight ends and night begins. The terminator phase, or defect of illumination, is given in seconds of subtended arc on the apparent disk, or in degrees (i), or as the ratio (k) of the illuminated disk to the geometric disk The sunset terminator appears on the east side, or evening limb, before opposition; and after opposition, the terminator becomes the sunrise line on the morning limb on the west side. At opposition there is no perceptible phase defect.

The Axial Tilt is the declination of the planet Earth (De) as seen from Mars defines the axial tilt of Mars relative to Earth. De is also equal to the areographic latitude of the center of the Martian disk, which is known as the sub-earth point. The latitude is positive if the Martian north pole is tilted toward Earth and negative if the Martian south pole is tilted toward Earth. This quantity is an important factor when drawing Mars or when trying to identify certain features. Mars' axial tilt is 25°.2 with respect to its orbital plane.

Drawing the Martian Disk

Anyone who observes Mars will find it rewarding to make a sketch of whatever is seen, both to create a permanent record and to help train the eye in detecting elusive detail. Start with a circle 1.65 inches (42 mm) in diameter, drawn on a 3 x 5 or 4 x 6-inch card. Draw the phase defect, if any, and the bright polar caps or cloud hoods. Next shade in the largest dark markings, being careful to place them in exactly the right locations on the disk. At this stage, record the time in UT to the nearest minute. Now add the finer details, viewing through various color filters, starting at the planet's sunset limb. Finally, note the UT date, observer's name, the instrument(s) used, and any other relevant information.

The following discussion is just a suggestion for producing a planetary drawing. Most observers use their own methods which have been derived from their own experiences to render their disk drawings.

At the beginning of an observing session, center Mars in the field of the eyepiece and obtain a sharp focus using the planetary limb, polar cap, or a large, dark, central feature. Make an overview of the general appearance of Mars, and estimate the quality of seeing (standard ALPO Scale, ranging from 0 for worst to 10 for perfect) and atmospheric transparency (the limiting naked-eye stellar magnitude in the vicinity of the planet). Note the phase and the planet's axial tilt relative to your field of view. Identify familiar surface features with the aid of a yellow or red filter. Locate clouds and limb hazes with a blue filter.

Note on your card the starting and ending times and compute the corresponding the CMs that are on the Martian disk in order to recognize the gross features that you have just seen. Locate and draw the outline of the bright north polar cap, normally at the bottom of the drawing disk. If the south polar cap in present, locate it at the top. If a polar hood is seen, sketch in a dashed boundary outline of the proper size.

Using the centers of both the telescopic image of Mars and the pencil disk as references, carefully draw in the darkest or largest feature relative to the center of the disk. Using the north and south points of the disk and the plotted dark feature as perspective guides, locate and sketch other dark features. This process should take no longer than 10 or 15 minutes with fair seeing. You now have 40 to 50 minutes to study Mars with the aid of color filters for fine surface details, bright frost patches (indicate with dotted outlines), white or blue clouds (use dashed outlines), and yellow dust clouds (dashed outlines). Sketch them at their proper positions on the drawing disk before they rotate off the Martian disk.

The sequence of making a Mars drawing is shown in Figure 2.

Summary

The ancient art of visual observation at the telescope is still a most useful tool for the modern astronomer, and is the forte of the amateur astronomer. In 2000-2002 we will be fortunate in that Mars will be very favorably positioned for telescopic study. This is especially important in view of the space missions to Mars planned for the near future.

Today's amateurs contribute most of man's knowledge about current weather and surface conditions on Mars. With a set of color filters and a high-quality telescope of 4 to 16 inches (10-40 cm) in aperture, the amateur can conduct professional-quality telescopic work in planetary research. A well-equipped observer using a CCD camera has the further opportunity to produce objective and quantitative records of the changing Red Planet.

[Editor's Note: Observations such as those described above are useful to the planetary science community only if they are made available to others. All Mars observations, of whatever form, should be sent to our Mars Section, whose staff addresses are given later in this issue.

The 2000-2002 Apparition is the best opportunity since 1988 for observing Mars. The apparition runs between the Mars-Sun conjunctions of 2000 Jul 01 to 2002 Aug 10, with opposition on 2001 Jun 13. Mars' closest approach to Earth occurs on 2001 Jun 21, when the planet's angular diameter will be 20".8, although its southerly declination of -26°.7 will favor observers in the southern hemisphere.]

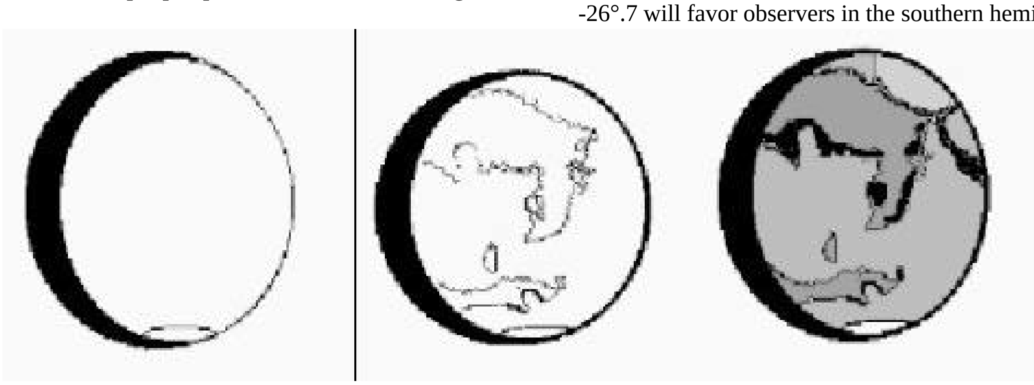

Figure 2: Visual Drawing Sequence of Mars. Suggestions for a five-step drawing sequence of Mars at the telescope: 1) Draw phase terminator, if present; 2) draw polar cap(s), south at the top and north at the bottom, if either or both are visible; 3) fill in rough outline of surface features; 4) darken familiar features and fine details; and 5) draw in detail of new or changing surface features. Drafted by J.D. Beish

Observations of the Remote Planets in 1998

By: Richard W. Schmude, Jr., coordinator, ALPO Remote Planets Section

Abstract

Photoelectric magnitude measurements were made for Uranus and Neptune in 1998 and the selected normalized magnitudes for Uranus are: B(1,0) = -6.66±0.02 and V(1,0) = -7.16±.0.01;the corresponding values for Neptune are: B(1,0) = -6.62±0.02 and V(1,0) = -6.98±0.01. Unfiltered CCD images made on 1998 Aug 01-02 are consistent with Titania being 0.1 magnitudes brighter than Oberon. The brightness of Pluto changed by 0.40±0.10 magnitudes over an 11-day period according to unfiltered CCD images. Telescopic studies revealed few or no albedo features on Uranus and Neptune except for limb darkening.

Introduction

During 1998, several developments took place, related to the Remote Planets -- Uranus, Neptune and Pluto. For example, results of a recent occultation of a star by Neptune's largest moon, Triton, revealed that Triton may be getting warmer [Elliot, 1999, 46; Elliot et al., 1998, 1107]. Karkoschka and Tomasko [1998, 1097] reported that red and infrared images of Uranus taken by the Hubble Space Telescope exhibited distinct albedo variations.

It was also suggested that Uranus may display a large seasonal change in albedo due to changing orientation; an infrared picture of Uranus is shown in Sky & Telescope [Feb. 1999, 20]. Lockwood and Thompson [1999, 2] reported that the brightness of Uranus had changed between 1972 and 1996, using the Stromgren y filter. Hammel and Lockwood [1997, 466] reported that several atmospheric features on Neptune had changed in the mid-1990s. Finally Hubble Space Telescope pictures showed that Neptune is constantly changing its appearance in the infrared [Sromovsky et al. 1998, 1098]. In addition, changes in the atmospheres of Uranus and Neptune may lead to changes in the brightness and appearance of these two planets in the visible portion of the spectrum. During 1998, ten people participated in the observing programs of the ALPO Remote Planets Section. During 1998, the appearance and brightness of Uranus and Neptune were monitored, the light curve of Pluto was measured and the relative brightness of Titania and Oberon was measured.

The names, locations and forms of observations of the individuals who conducted observations or other measurements of the Remote Planets in 1998 are summarized in Table 1. Table 2 lists the characteristics of the 1998 Apparitions of Uranus, Neptune and Pluto.

Observer and Location	Type of Observation
Normal Boisclair, South Glenn Falls, NY	V
Tom Faber, Villa Rica, GA	PP
Lawrence Garrett, Fairfax, VT	V
Robin Gray, Paradise Hill, NV	V, VP
Rick Hill, Tucson, AZ	CCD
Brian Loader, New Zealand	PP
Raffaello Lena, Italy	V
Frank Melillo, Holtsville, NY	PP, CCD
Richard Schmude, Jr., Villa Rica, GA	PP, VP
Richard Schmude, Jr., Barnesville, GA	PP, VP
Roger Venable, Wrens, GA	V

Legend
CCD = CCD image
PP = photoelectric photometry
V = visible
VP = visual photometry

Table 2: Contributors to the ALPO Remote Planets Section, 1998

Parameter	*Uranus*	*Neptune*	*Pluto*
First conjunction date	1998 Jan 28	1998 Jan 19	1997 Nov 27
Opposition date	1998 Aug 03	1998 Jul 23	1998 May 28
Angular diameter (opposition)	3".71	2".30	0". 11
Right ascension (opposition)	20h 54m	20h 12m	16h 28m
Declination (opposition)	-18°.2	-19°.6	-9°.2
Second conjunction date	1999 Feb 02	1999 Jan 22	1998 Nov 30

Table 1: Characteristics of the 1998 Apparitions of Uranus, Neptune and Pluto; data taken from 1997, 1998 and 1999 *Astronomical Almanac*.

Photoelectric Photometry

Four persons either submitted, or assisted in the gathering of, photoelectric magnitude measurements of the Remote Planets in 1998. In all cases, an SSP-3 solid-state photometer was used; this instrument is described elsewhere [Optec, 1988; Schmude, 1992, 20]. Brian Loader carried out a series of photoelectric measurements from the South Island of New Zealand (172° 41' 54" E/43° 28' 46" S). He used a 0.20-m Schmidt-Cassegrain telescope. Frank Melillo of Holtsville, New York, also used a 0.20-m Schmidt-Cassegrain, while the author used a 0.51-m Newtonian near Villa Rica, Georgia. In addition, Frank Melillo submitted unfiltered charged-coupled device (CCD) images of Titania and Oberon in 1998. These magnitude measurements have added to our knowledge of the color and brightness of Uranus and Neptune and have also yielded a light curve of Pluto. The magnitudes and positions of the comparison stars used in the photoelectric studies are listed in Table 3.

	Position (2000.0)		Magnitude		
Star	**R.A.**	**Dec.**	**B**	**V**	**I**
			+	+	+
HD196078	20h 35.5m	-16°32'	6.39	6.19	--
q Cap	21h 05.9m	-17°14'	4.06	4.07	4.06
Hip 102780	20h 49.4m	-18°02'	7.61	6.21	--
19 Cap	20h 54.8m	-17°55'	6.90	5.78	--
u Cap	20h 40.1m	-18°08'	6.81	5.15	--
SAO 163261	20h 06.2m	-19°30'	(7.6)	7.67	--
Hip 99391	20h 10.4m	-19°23'	7.86	7.28	--

Notes: "HD" refers to the *Henry Draper Catalog*, "Hip" to the *Hipparchus Catalog*; and "SAO" to the *Smithsonian Astrophysical Observatory Catalog*.

Table 3: Comparison Stars used for B, V and I Photoelectric Photometric Measurements of Uranus and Neptune in 1998

Individual photoelectric magnitude measurements of Uranus are listed in Table 4 (p. 15) while individual measurements for Neptune are listed in Table 5 (p. 15); all magnitudes have been corrected for extinction and transformation. The transformation coefficients were calculated using the two-star method as outlined in Hall and Genet [1988, 199]. On 1998 Jul 19 and 22, the author also measured the B and V magnitudes of a check star, q Capricornis, and the resulting measured magnitudes were: B = +4.07±0.01 (mean of three measurements) and V = +4.08±0.01 (mean of six measurements). The corresponding literature magnitudes for q Cap are: B = +4.06 and V = +4.07 [United States Naval Observatory, 1999, H28]. The mean normalized magnitudes of Uranus and Neptune for 1998 are listed in Table 6. The average V(1,0) value for Uranus is consistent with results from previous years; however, the B(1,0) value is a little brighter than expected. The V(1,0) magnitude for Neptune is about the same as the values for the three previous years; however, the B(1,0) magnitude is a little brighter than values in 1995 and 1996. [The V(1,0) and B(1,0) magnitudes are visual and blue magnitudes, respectively, reduced to a Sun-planet and planet-Earth distance of 1.0 astronomical units. Ed.]

Visual Photometry

A total of 117 visual magnitude estimates of Uranus and Neptune were made in 1998. The mean normalized visual magnitude for Uranus is Vvis(1,0) = -7.1±0.02 based on 64 measurements, while the corresponding value for Neptune based on 53 estimates is Vvis(1,0) = -7.0±0.01. The uncertainties were calculated from $\sigma\sqrt{N}$ where σ is the standard deviation and N is the number of estimates (64 for Uranus and 53 for Neptune). The uncertainties do not include possible systematic errors arising from differences in comparison-star and planet color or in atmospheric extinction.

Uranus and Neptune Disk Appearance

Four individuals submitted visual observations of Uranus and Neptune during 1998 and their observations are summarized in Table 7. Uranus usually did not show much detail. However, on 1998 Oct 24 Robin Gray observed a vague spot on Uranus, slightly brighter than its surroundings. The ALPO Remote Planets Coordinator welcomes visual studies of both Uranus and Neptune; note that high magnifications and good seeing are required because of the small angular sizes of these two planets. Spots are occasionally visible on Uranus; one was seen on 1988 Jul 16 by the author [Schmude, 1988, 86].

Oberon and Titania

Frank Melillo made a series of CCD images of both Uranus and Neptune during July and August 1998. He used a Starlight Xpress MX5 16 CCD camera, which has a Sony chip with a peak spectral response at 550 nanometers. The chip has 5105290 pixels with a pixel size of 12.659.8 mm. Each image had a total exposure time of 60 seconds. In two of the CCD

1998 UT Date	Filter	Magnitude Meas	Norm.	Comparison Star	+Air Mass: Planet-Star	1998 UT Date	Filter	Magnitude Meas.	Norm.	Comparison Star	+ Air Mass: Planet-Star
		+	-					+	-		
July						Aug					
19.228	V	5.76	7.11	HD 196078	+0.106	01.208	V	5.72*	7.15*	q Cap	-0.01
19.237	V	5.72	7.15	"	+0.091	02.208	V	5.71*	7.16*	"	-0.01
19.243	V	5.66	7.21	"	+0.086	03.208	V	5.69*	7.18*	"	-0.01
19.252	V	5.67	7.20	"	+0.071	04.208	V	5.71*	7.16*	"	-0.01
19.262	V	5.71	7.16	"	+0.060	20.208	V	5.73*	7.14*	"	-0.01
19.272	V	5.70	7.17	"	+0.047						
19.310	V	5.71	7.16	"	+0.016	Sept					
19.325	V	5.72	7.16	"	-0.009	12.375	V	5.72	7.18	Hip 102780	-0.01
19.340	V	5.76	7.11	"	-0.025	12.382	V	5.75	7.15	19 Cap	-0.01
19.363	V	5.83	7.04	"	-0.095	16.347	V	5.75	7.15	Hip 102780	0.00
19.380	V	5.69	7.18	"	-0.089	16.358	V	5.72	7.18	19 Cap	-0.02
22.173	B	6.15	6.71	"	+0.287	21.345	V	5.77	7.14	Hip 102780	-0.01
22.176	V	5.72	7.15	"	+0.271	21.350	V	5.75	7.15	u Cap	0.00
22.204	B	6.25	6.62	"	+0.112	21.358	V	5.76	7.15	Hip 102780	-0.01
22.207	V	5.72	7.15	"	+0.118	22.372	V	5.80	7.11	"	-0.01
22.220	B	6.29	6.58	"	+0.114	22.375	V	5.78	7.13	"	-0.01
22.223	V	5.77	7.10	"	+0.107	22.380	V	5.75	7.16	"	-0.01
22.243	B	6.19	6.68	"	+0.076						
22.245	V	5.70	7.17	"	+0.072	Oct					
22.260	B	6.19	6.68	"	+0.057	17.384	V	5.77	7.18	Hip 102780	-0.01
22.263	V	5.68	7.18	"	+0.054	17.389	V	5.76	7.19	"	-0.01
22.286	B	6.22	6.65	"	+0.035	24.388	V	5.75	7.22	"	-0.01
22.289	V	5.69	7.18	"	+0.035						
22.328	V	5.66	7.21	"	+0.012	Nov					
22.331	B	6.13	6.74	"	+0.008	09.417	V	5.87	7.12	Hip 102780	-0.02
22.350	B	6.23	6.64	"	-0.050	09.423	V	5.86*	7.13*	"	-0.05
22.352	V	5.71	7.16	"	-0.054						
22.378	B	6.27	6.60	"	-0.061						
22.381	V	5.74	7.13	"	-0.056						
22.397	B	6.20	6.67	"	-0.150						
22.400	V	5.69	7.18	"	-0.133						

*Extinction coefficient assumed to equal0.26 magnitude./air mass.

Table 5: Photoelectric Measured and Normalized Magnitudes of Uranus in 1998.

images, the relative brightness of Titania and Oberon were measured, with the results listed below:

1998 Aug 01, 05h00m UT: Oberon is 0.14 magnitudes fainter than Titania.

Number of measurements in brackets.

Planet	Normalized Magnitude B(1,0)	V(1,0)	B - V
Uranus -	6.66±0.02 [10]	-7.16±0.01 [4	+0.50±0.02
Neptune -	6.62±0.02 [11]	-6.98±0.01 [3	+0.36±0.02

Table 5: Selected normalized magnitudes for Uranus and Neptune in 1998

1998 Aug 02, 05h00m UT: Oberon is 0.07 magnitudes fainter than Titania.

Both relative brightness measurements were made from unfiltered CCD images. The 1999 Astronomical Almanac lists Titania as being 0.21 magnitudes brighter than Oberon in the V band. Oberon and Titania are gradually showing their equatorial regions and thus their relative brightness may be different than in 1986 when Voyager 2 flew past Uranus.

Pluto

Richard Hill submitted CCD images showing the path that Pluto followed during May and July 1998. Frank Melillo took several unfiltered CCD images of Pluto with a 0.20-m Schmidt-Cassegrain telescope o

1998 UT Date	Filter	Magnitude Meas.	Magnitude Norm.	Comparison Star	+Air Mass: Planet-Star
		+	-		
July					
19.307	V	7.66	7.06	HD 196078	+0.198
19.322	V	7.73	6.99	"	+0.236
19.336	V	7.69	7.03	"	+0.287
19.347	V	7.80	6.92	"	+0.340
19.376	V	7.73	6.99	"	+0.378
22.160	B	8.07	6.65	"	+0.052
22.163	V	7.75	6.97	"	+0.050
22.184	B	8.12	6.60	"	-0.040
22.187	V	7.81	6.91	"	-0.035
22.198	B	8.1	6.58	"	+0.050
22.200	V	7.79	6.93	"	+0.053
22.214	B	8.14	6.57	"	+0.079
22.217	V	7.76	6.96	"	+0.079
22.237	B	8.16	6.55	"	+0.093
22.240	V	7.75	6.97	"	+0.094
22.254	B	8.05	6.67	"	+0.110
22.257	V	7.73	6.99	"	+0.112
22.278	B	8.09	6.62	"	+0.139
22.281	V	7.78	6.94	"	+0.143
22.322	B	8.0	6.72	"	+0.250
22.234	V	7.68	7.04	"	+0.254
22.344	B	8.21	6.51	"	+0.302
22.347	V	7.73	6.99	"	+0.317
22.370	B	8.00	6.72	"	+0.483
22.373	V	7.70	7.02	"	+0.525
22.391	B	8.12	6.60	"	+0.784
22.393	V	7.69	7.03	"	+0.848

1998 UT Date	Filter	Magnitude Meas.	Magnitude Norm.	Comparison Star	+Air Mass: Planet-Star
		+	-		
Sept					
12.389	V	7.80	6.94	SAO 163261	0.00
12.394	V	7.81	6.93	"	0.00
16.369	V	7.76	6.99	"	0.00
16.374	V	7.80	6.95	"	0.00
16.378	V	7.78	6.97	Hip 99391	0.00
21.368	V	7.76	7.00	SAO 163261	0.00
21.372	V	7.78	6.97	"	0.00
22.359	V	7.66	7.09	"	0.00
22.361	V	7.68	7.07	"	0.00
Oct					
17.371	V	7.82	6.96	SAO 163261	-0.01
17.375	V	7.86	6.93	"	-0.01
24.376	V	7.83	6.96	"	-0.02
24.381	V	7.83	6.96	"	-0.01
Nov					
09.405	V	7.88*	6.93*	SAO 163261	-0.07
09.410	V	7.85*	6.96*	"	-0.06

*Extinction coefficient assumed to equal 0.26 magnitude/air mass

Table 7: Photoelectric Measured and Normalized Magnitudes of Neptune in 1998.

ver an 11-day period. He measured the brightness of Pluto with respect to a ca. +12.5-magnitude comparison star at R.A. 16h28m09s (±2S), Dec. -9°11’46" (±30"). Pluto was just north of the comparison star on 1998 May 26, which is shown in a Pluto finder chart [MacRobert, 1998, 97]. Frank Melillo’s results are plotted in Figure 1; the dashed curve is a fit to the data based on a rotational period of 6.3872 days. Based on his data, Melillo suggests that Pluto changed in brightness by 0.40±0.10 magnitude as it rotated in late May-early June, 1998.

The corresponding changes in brightness for Pluto during rotation in previous studies were 0.12 magnitudes (1953-55) and 0.25 magnitudes (1985) [Cruik-shank and Morrison, 1990, 204]. The steady increase in the brightness change from the 1950s to 1998 is consistent with the disappearance of snow and frost on the surface of Pluto over the last 45 years.

Conclusions

Members of the ALPO Remote Planets Section submitted photoelectric magnitude measurements of Uranus and Neptune along with visual observations and CCD images of all three planets. The V(1,0) magnitudes of Uranus and Neptune are consistent with values in previous years. The disk of Uranus did not show much detail. The light curve of Pluto was measured with a CCD camera and the total change in brightness is estimated to be 0.40±0.10 magnitudes.

Acknowledgments

The author wishes to thank each person who submitted observations of the Remote Planets for their 1998 Apparitions.

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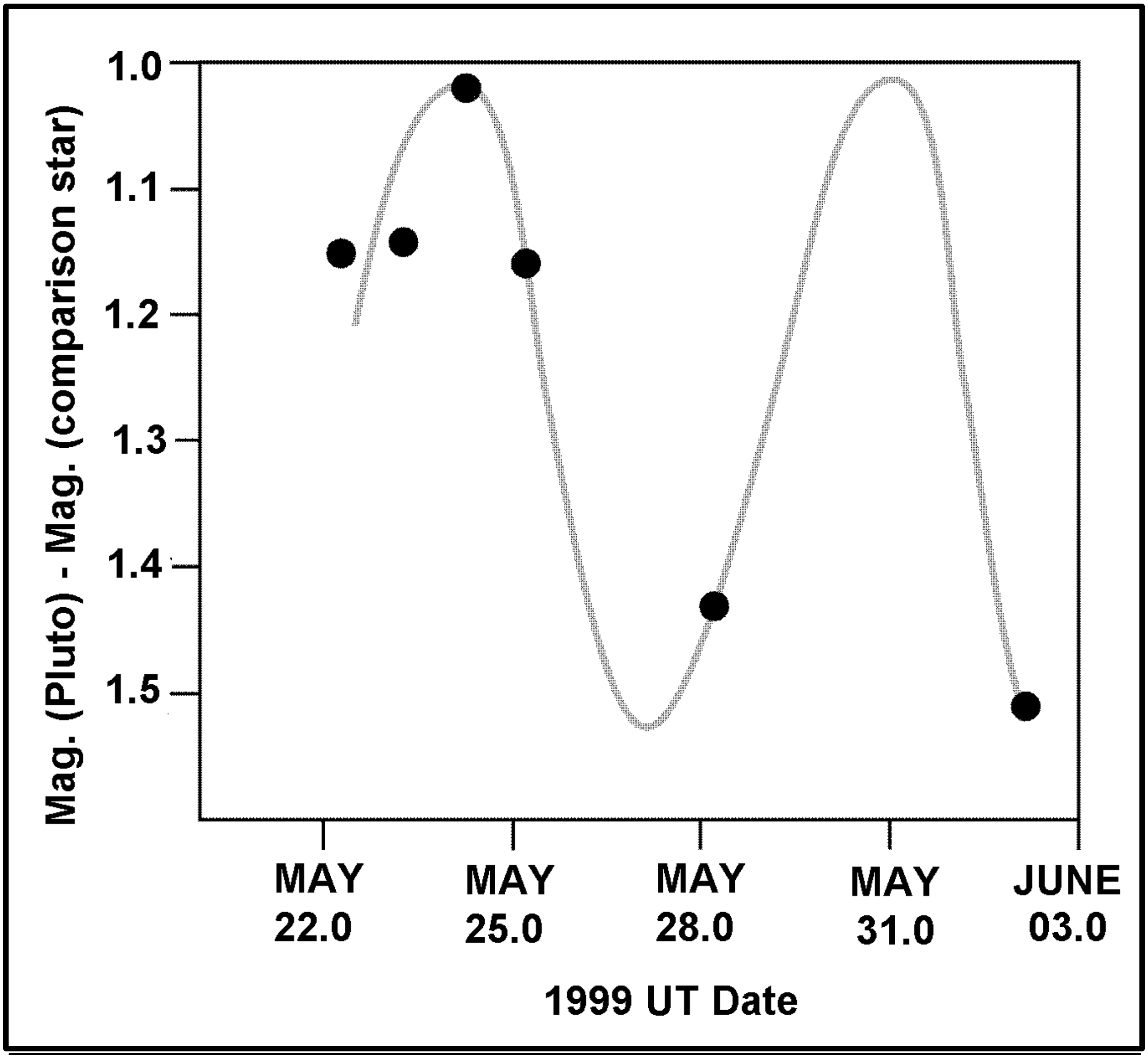

Figure 1: Relative magnitudes of Pluto and a nearby comparison star, based on unfiltered CCD images made by Frank Melillo in late May and early June, 1998

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Table 6: Summary of Visual Telescopic Studies of Uranus and Neptune in 1998.

1998 UT Date	Telescope Aper.	Type	Mag.	Filter	Seeing	Comments
Jul 16.923	0.25 m	S-C	200X	none	-	Uranus had an asymmetric area of unusually high albedo which is consistent with CCD images taken in 1995.
Aug 13.173	0.51 m	Newt	640X	WB	3	The limb of Neptune appears moderately stable. The planetary disk shows very pronounced limb darkening. No dusky belts or bright zones are suspected.
Aug 13.198	0.51 m	Newt	508X	W8	3	Uranus shows little limb darkening and no dusky belts, bright zones, faint variations or albedo irregularities. Uranus has a yellow to greenish color.
Aug 17.210	0.15 m	Rfr	253X, 310X	W8,IL	4	Central area of Uranus is brighter than limb with and without #8 filter; no other disk details are visible.
Aug 21.306	0.15 m	Rfr	375X*	W8, IL	5	No details or irregularities are visible on the disc of Uranus even though the limb of the planet is sharp for brief instances.
Sep 15.069	0.15 m	Rfr	375X*	W8, IL	6	The limb of Uranus is sharp even at 375X, no details are visible; uniform brightness across the disk.
Sep 26.188	0.40 m	Newt	320X	W80A	9	Suspected a trace of darkening near the ENE limb of Uranus -- this is residual chromatic dispersion. Limb darkening was evident
Oct 24.144	0.15 m	Rfr	310X	IL	6	One vague, slightly bright spot was visible on the disk of Uranus -- this spot was not seen all of the time.
Oct 27.219	0.15 m	Rfr	310X	W82A, IL	5	No details are visible on the disc of Uranus either with or without filter.

Notes: * = other magnifications also used. IL = Integrated light, Newt = Newtonian, Rfr = refractor, S-C = Schmidt-Cassegrain. Seeing is in the ALPO Scale, ranging from 0 = worst to 10 = perfect. Wratten filters: W8 = light yellow, W80A & W82A = blue.

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Observations of Saturn During the 1996-97 Apparition

By: Julius L. Benton, Jr., Coordinator, ALPO Saturn Section

Abstract

Visual, photographic, and CCD observations were submitted to the ALPO Saturn Section by program participants in the United States, Canada, Germany, and the United Kingdom during the 1996-97 Apparition, covering the period 1996 Jun 23 to 1997 Feb 17. Telescopes that were employed ranged in aperture from 11.4 cm (4.5 in.) to 51.0 cm (20.0 in.). ALPO observers called attention to recurring festoons and other dusky disturbances among the belts and zones of the southern hemisphere of Saturn during the apparition, but the main highlight of 1996-97 was the emergence of a series of relatively bright but somewhat diffuse white ovals in the Southern Equatorial Zone (EZs) in late 1996 September. As the apparition progressed, the EZs white features spread out across the globe at that latitude, resulting in an EZs that remained elevated in brightness through the end of the observing season. Saturn observers attempted central meridian (CM) transit timings of bright and dark global phenomena to try to establish rotation rates for different latitudes. During the 1996-97 Apparition, the inclination of the ring system to our line of sight, "B", reached a maximum value of -6°.198 on 1996 Jul 12. With the rings gradually beginning to open up following the edgewise ring presentations of 1995-96, more and more of the southern hemisphere of Saturn's globe and the south face of the rings are becoming visible. Accompanying this report are references, drawings, photographs, graphs, and tables.

Introduction

Members of the ALPO Saturn Section contributed a meaningful collection of visual, photographic, and CCD observations of the planet and its ring system during the 1996-97 Apparition. This analytical synopsis, which is enhanced by drawings, photographs, and CCD images, is based upon data received for the observing period 1996 Jun 23 through 1997 Feb 17 (here referred to as the 1996-97 observing season, or Apparition). All dates and times in this report are in Universal Time (UT).

Conjunction	1996 Mar 17 19h UT
Opposition	1996 Sep 26 19
Conjunction	1997 Mar 30 22

Opposition Data:	
Visual Magnitude	+0.5
Declination	-0°.83
B	-4°.47
B'	-4°.70
Globe	
Equatorial Diameter	19".47
Polar Diameter	17".39
Rings	
Major Axis	44".39
Minor Axis	3".46

Table 1. Geocentric Phenomena for Saturn During the 1996-97 Apparition

Table 1 lists geocentric data in UT for the 1996-97 Apparition of Saturn. Throughout the observing season, the numerical value of B, that is, the saturnicentric latitude of the Earth referred to the ring plane (negative when south), ranged between the extremes of -6°.20 (1996 Jul 12) to -3°.03 (1996 Nov 29). The value of "B'", that is, the saturnicentric latitude of the Sun, ranged from -6°.80 (1997 Feb 17) to -3°.30 (1996 Jun 23).

Table 2 lists the 17 individuals who submitted a total of 160 observations to the ALPO Saturn Section for the 1996-97 Apparition, along with their observing sites, number of dates of observations, and descriptions of their telescopes.

Figure 1, a histogram, gives the distribution of observations by month, showing that most of the data were amassed during the months of 1996 September through 1997 January (85.0 percent), with a decline in the number of observations on either side of this peak. Of the submitted observations, 23.2 percent were made before opposition (1996 Sep 26), 1.3

Table 2: Contributing observers, 1996-97 Apparition of Saturn.

Observer & Location	No. of Obser	Telescope Data
Barton, Johnny	1	31.8 cm (12.5 in.) NEW
Waco, TX		
Benton, Julius L., Jr.	40	25.4 cm (10.0 in.) REF
Wilmington Isl, GA		
Boyar, Dan	2	15.2 cm (6.0 in.) REF
Boynton Beach, FL		
Cave, Thomas R	2	32.5 cm (12.8 in.) NEW
Long Beach, CA		
Cole-Arnal, Oscar	1	12.7 cm (5.0 in.) REF
Waterloo, Ontario	1	15.2 cm (6.0 in.) REF,
Canada	3	25.4 cm (10.0 in.) SC
Haas, Walter H.	8	31.8 cm (12.5 in.) NEW
Las Cruces, NM		
Heath, Alan W.	16	30.5 cm(12.0 in.) NEW
Nottingham, UK		
Hernandez, Carlos E.	2	20.3 cm (8.0 in.) NEW
Miami, FL	1	40.6 cm (16.0 in.) SC
McAnally, John W.	10	11.4 cm (4.5 in.) NEW
Waco, TX	12	20.3 cm (8.0 in.) SC
Melillo, Frank J.	4	20.3 cm (8.0 in.) SC
Holtsville, NY		
Niechoy, Detlev	33	20.3 cm (8.0 in.) SC
Gšttingen, Germany		
Nowak, Gary T.	2	25.4 cm (10.0 in.)SCHF
Hinesbury, VT		
Parker, Donald C.	4	40.6 cm (16.0 in.) NEW
Coral Gables, FL		
Plante, Phil	5	20.3 cm (8.0 in.) REF
Poland, OH	3	20.3 cm (8.0 in.) SC
	1	40.6 cm (16.0 in.) CAS
Post, Cecil	1	20.3 cm (8.0 in.) NEW
Las Cruces, NM		
Schmude, Richard W.	1	25.4 cm (10.0 in.) NEW
Barnesville, GA	2	51.0 cm (20.0 in.) NEW
Will, Matthew	5	20.3 cm (8.0 in.) NEW
Springfield, IL		
Total Observations:	160	
Total Observers:	17	
* CAS = Cassegrain, NEW = Newtonian, REF = Refractor, SC = Schmidt-Cassegrain, SCHF = Schiefspiegler		

percent actually on that date, and 75.5 percent were made after opposition. While an intense scrutiny of Saturn in the months centered on the date of opposition is very gratifying, it remains our objective

to achieve, as much as possible, a continual coverage of the planet throughout any given apparition. Therefore, we strongly encourage observers to begin viewing the planet when it first appears in the eastern sky before dawn and continue their investigations until Saturn approaches conjunction with the Sun.

Figure 2 depicts the observer base (total of 17) of the ALPO Saturn Section for 1996-97, as well as the international distribution of the 160 observations that were contributed. During the apparition, the United States accounted for 66.3 percent of the submitted observations and about four-fifths of the participating observers (82.4 percent). International participation in our programs continued during 1996-97, with observers in Canada, the United. Kingdom, and Germany submitting reports. As always, it is the desire of the ALPO Saturn Section to enlist as many dedicated observers throughout the world as possible.

Figure 3 graphs the number of observations by instrument type, showing that telescopes of classical design (i.e., refractors, Newtonian reflectors, and Cassegrains) were used for nearly two-thirds (63.7 percent) of the 160 total observations in 1996-97. The

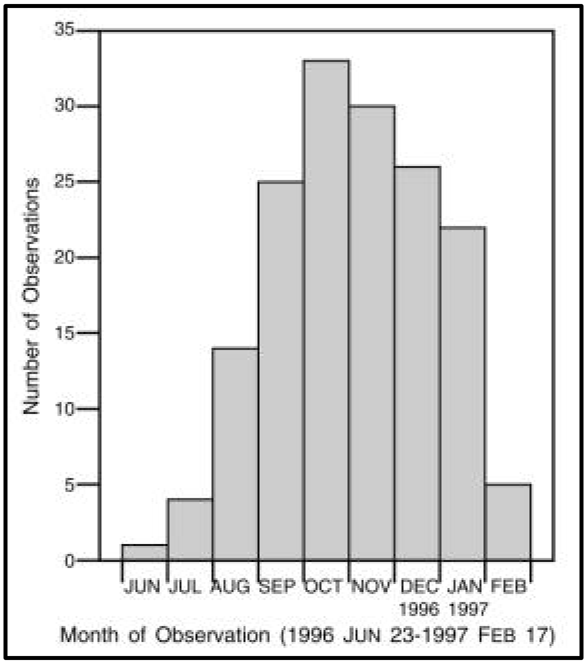

Figure 1. Distribution of observations by month, 1996-97 Apparition of Saturn

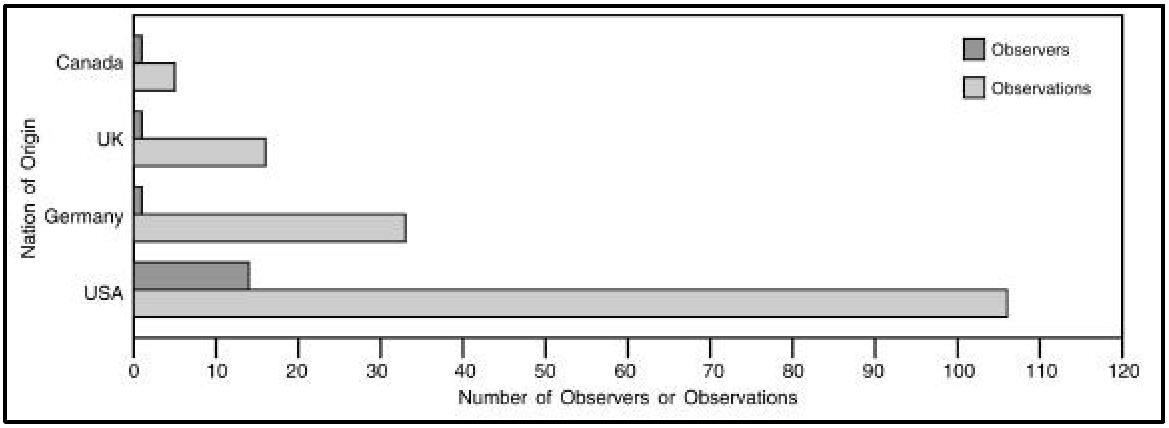

Figure 2. Distribution of observers and observations by nation of origin, 1996-97 Apparition of Saturn

exceptional image contrast and resolution of such instruments frequently make them the telescopes of choice for many individuals seeking an optical system purely for planetary work. Also, 93.1 percent of the total observations were made with instruments equal to or greater than 15.2 cm (6.0 in.) in aperture. In recent years, there has been a growing percentage of larger apertures used for ALPO observations of Saturn, and based on the comments of our more experienced planetary observers, there appears to be more emphasis now on aperture when selecting a telescope than there is on any specific design. Of course, optical quality should always be the main prerequisite for any lunar and planetary telescope. Note, however, that observers using smaller apertures of the order of 10.2 cm (4.0 in.) can still contribute useful work on Saturn.

The writer expresses his gratitude to all of the dedicated individuals mentioned in Table 2 who faithfully submitted their work to the ALPO Saturn Section for the 1996-97 Apparition. Those interested in Saturn studies throughout the United States and elsewhere are encouraged to become part of our observing team in future apparitions as we continue our efforts to maintain an international comprehensive surveillance of the planet. Beginning observers are also welcome, and the ALPO Training Program and the ALPO Saturn Section will be pleased to jointly provide instructive guidance for newcomers to our programs.

The Globe of Saturn

This article is derived from a reduction of 160 observational reports that were contributed to the ALPO Saturn Section by the 17 observers in Table 2. To preserve brevity, names of observers are necessarily omitted from the text except when the identity of an individual is pertinent to the discussion. Tables, graphs, drawings, photographs, and CCD images accompany this observational summary, and we urge readers to refer to them as they study this analysis. Also, features on the globe of Saturn are described in south-to-north order and can be identified by reference to the nomenclature diagram in Figure 4.

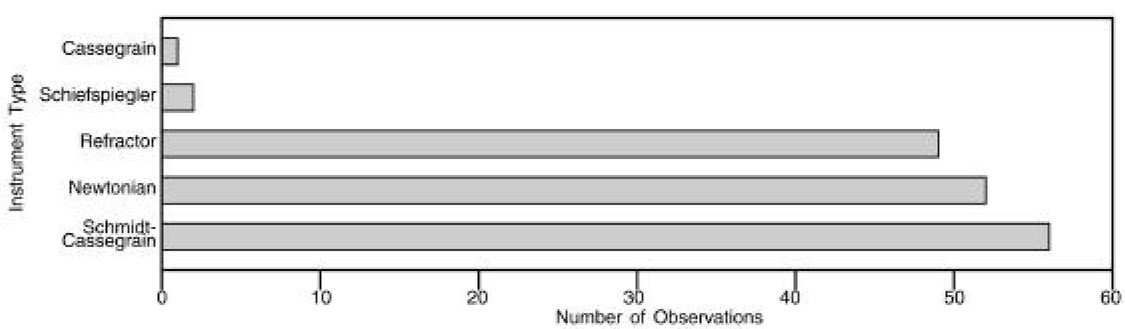

Figure 3. Distribution of observations by instrument type, 1996-97 Apparition of Saturn

1996-97 Relative Intensities					
Globe/Ring Feature	**Number of Estimates**	**Mean and Standard Error**		**Change Since 1995-96**	**"Mean" Derived Color i 1996-97**
Zones, Hemispheres, Regions and Caps:					
SPC	1	4.00	----	-0.06	Grey
SPR	15	4.72	±0.91	-0.54	Yellowish-Grey
SSTeZ	14	5.96	±0.30	+0.01	Yellowish-White
STeZ	10	5.88	±0.41	-0.43	Yellowish-White
STrZ	10	5.52	±0.94	-0.28	Dull Yellowish-White
SEBZ	2	6.50	±0.50	+2.50	Pale Yellowish-White
EZs	46	7.33	±0.71	+0.77	Bright Yellowish-White
Globe S of Rings	9	5.96	±0.57	+0.04	Dusky Yellowish-Grey
Globe N of Rings	11	4.59	±0.45	+0.14	Dusky Yellowish-Grey
EZn	24	6.65	±0.85	-0.24	Pale Yellowish-White
NTrZ	12	6.04	±0.92	+0.47	Yellowish-White
NTeZ	6	5.92	±0.19	-0.07	Yellowish-White
NNTeZ	1	5.50	---	-0.43	Dull Yellowish-White
NPR	18	4.42	±1.04	-0.51	Dull Yellowish-Grey
Belts:					
SSTeB	1	5.00	---	-0.12	Greyish
STeB	11	4.82	±0.57	-0.08	Greyish
SEB (entire)	45	3.30	±0.58	-1.01	Greyish-Brown
SEBs	2	3.00	±0.00	-1.88	Dark Grey
SEBn	2	3.00	±0.00	-2.18	Dark Grey
EB	1	3.00	---	-1.09	Dark Grey
NEB (entire)	46	3.89	±0.61	+0.00	Greyish-Brown
NTeB	7	5.00	±0.00	-0.14	Light Grey
Rings:					
A (entire)	15	6.83	±0.34	+2.14	Yellowish-White
A0 or B10	10	1.65	±1.02	-3.35	Greyish-Black
B (outer 1/3)	STANDARD	8.00	±0.00	---	White
B (inner 2/3)	3	6.33	±0.47	---	Yellowish-White
C (ansae)	2	4.50	±0.50	---	Dull Greyish
Crape Band	11	2.64	±1.17	---	Dark Greyish
Sh G on R	24	0.33	±0.62	-1.08	Dark Greyish-Black
Sh R on G	29	0.26	±0.54	-0.95	Dark Greyish-Black
TWS	1	8.50	---		White

NOTES: For nomenclature see text and Figure 4. A letter with a digit (e.g., A0 or B10) refers to a location in the Ring specified in terms of units of tenths of the distance from the inner edge to the outer edge. Visual numerical relative intensity estimates (visual surface photometry) are based upon the *ALPO Intensity Scale*, where 0.0 denotes complete black (shadow) and 10.0 refers to th most brilliant condition (very brightest Solar System objects). The adopted scale for Saturn uses a reference standard of 8.0 for t outer third of Ring B, which appears to remain stable in intensity for most Ring inclinations. All other features on the Globe or in t Rings are compared systematically using this scale, described in the *Saturn Handbook*, which is issued by the ALPO Saturn Section. The "Change Since 1995-96" is in the sense of the 1995-96 value subtracted from the 1996-97 value, "+" denoting an increase in brightness and "-" indicating a decrease (darkening). When the apparent change is less than about 3 times the standa error, it is probably not statistically significant. Note that several of the Ring components were not visible in the 1995-96 Appariti so their intensities cannot be compared with those for the 1996-97 Apparition.

Table 3. Visual Numerical Relative Intensity Estimates and Colors for the 1996-97 Apparition of Saturn

The continuing policy of the ALPO Saturn Section is to prepare apparition reports by comparing and contrasting data between successive apparitions for global atmospheric features. This tradition maintains continuity and helps the reader understand the often subtle, but discernible, variations that may be occurring seasonally on Saturn. Observational results suggest that the constantly changing inclination of Saturn's axis of rotation relative to the Sun and Earth contributes to any perceived variations in belt and zone intensities, which are listed in Table 3. Recent photoelectric photometry of Saturn has demonstrated that the planet exhibits oscillations of about ±0.10 visual magnitude with time, and these data have prompted some investigators to postulate that transient and long-enduring atmospheric features in Saturn's belts and zones may help produce such brightness fluctuations. Regular photoelectric

Saturnian Belt	Form of Latitude (all values are in degrees)								
	Planetocentric			Eccentric			Planetographic		
S edge SEB	-21.2	±0.6	(+8.2)	-23.5	±0.6	(+8.2)	-26.0	±0.7	(+8.9)
N edge SEB	-15.7	±0.6	(+7.8)	-17.5	±0.6	(+8.2)	-19.5	±0.7	(+9.1)
S edge NEB	+14.3	±3.6	(-0.6)	+15.9	±4.0	(-1.4)	+17.7	±4.4	(-1.6)
N edge NEB	+19.0	±4.2	(-3.8)	+21.1	±4.6	(-4.1)	+23.3	±5.0	(-4.5)

NOTE: For nomenclature see Figure 4. Latitudes are calculated using the appropriate geocentric tilt, B, for each date of observation. Planetocentric latitude is the angle between the equator and the feature as seen from the center of the planet. Planetographic latitude is the angle between the surface normal and the equatorial plane. Eccentric, or "Mean," latitude is the arctangent of the geometric mean of the tangents of the other two latitudes. The change shown in parentheses is the result of subtracting the 1995-96 latitude value from the 1996-97 latitude value.

Table 7: Table 4. Saturnian Belt Latitudes in the 1996-97 Apparition

photometry of Saturn in conjunction with visual intensity estimates is a valuable project for suitably-equipped observers to initiate and maintain.

The intensity scale employed is the ALPO Standard Numerical Relative Intensity Scale, where 0.0 is total black and 10.0 is the brightest possible condition. This scale is normalized by setting the outer third of Ring B at a standard brightness of 8.0. The arithmetic sign of an intensity change is found by subtracting a feature's 1995-96 intensity from its 1996-97 intensity. Variations of only ±0.1 mean intensity points are not considered to be of any real significance. Likewise, a perceived intensity fluctuation is not considered really important unless it surpasses roughly three times its standard deviation.

For estimating Saturnian global latitudes in 1996-97, observers utilized the visual method pioneered by Haas during the 1960s. Using his method, estimates are made of the fraction of the polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the limb and the feature whose latitude is desired. Haas' procedure is easy to use and produces results that compare favorably with latitude values measured with a bifilar micrometer. After mathematical reduction, latitudes of Saturn's global features during 1996-97 appear in Table 4, but one must be cautious not to place too much confidence in data generated by only one or two observers. Haas and others have been employing the technique for many years with excellent and reliable results. Observers are encouraged to use this very simple procedure whenever possible, even if a bifilar micrometer is available; comparison of latitude data gathered by both methods is always useful. A full discussion of Haas' visual technique can be found in the *Saturn Handbook*. In discussing each feature on Saturn's globe, notes regarding latitude data are incorporated into the text where appropriate.

Southern Portions of the Globe

Improved views of the southern hemisphere of Saturn occurred during 1996-97 as these regions increasingly tilted into our line of sight following the 1995-96 edgewise apparition. Of course, correspondingly less of the northern hemisphere of the planet is now visible, but belts and zones at corresponding latitudes in both hemispheres could still be compared with one another in 1996-97. As a whole, observers reported that the southern hemisphere of Saturn appeared very slightly brighter than the planet's northern hemisphere in 1996-97 (by +1.37 mean intensity points), and this impression was similar to that in the immediately preceding apparition. Intermittent sightings of wispy festoons and transient dark features occurred among the belts and zones of the southern hemisphere of Saturn in 1996-97, although the most noteworthy activity seen in the observing season was a series of fairly prominent -- but diffuse -- white ovals in the Equatorial Zone (EZs), first appearing in late 1996 September. More will be discussed about this feature in the later section dealing with Saturn's Equatorial Zone. Also, other less prominent whitish spots were suspected in the SSTeZ during 1997 January and February.

- *South Polar Region (SPR)* -- The SPR showed a uniform yellowish-grey hue during 1996-97, with no discernible activity reported. The SPR had a mean intensity that differed by a factor of -0.54 from that of 1995-96, a variance that is considered to be of no real consequence. There was only one sighting in 1996-97 of an ill-defined, greyish South Polar Cap (SPC), which was slightly darker than its surroundings and of roughly the same mean intensity as in 1995-96. The South Polar Belt (SPB) encircling the SPR was not reported at all throughout the apparition.

- *South South Temperate Zone (SSTeZ)* -- The SSTeZ was sighted on several occasions during 1996-97, certainly far more frequently than the NNTeZ in the northern hemisphere. A derived

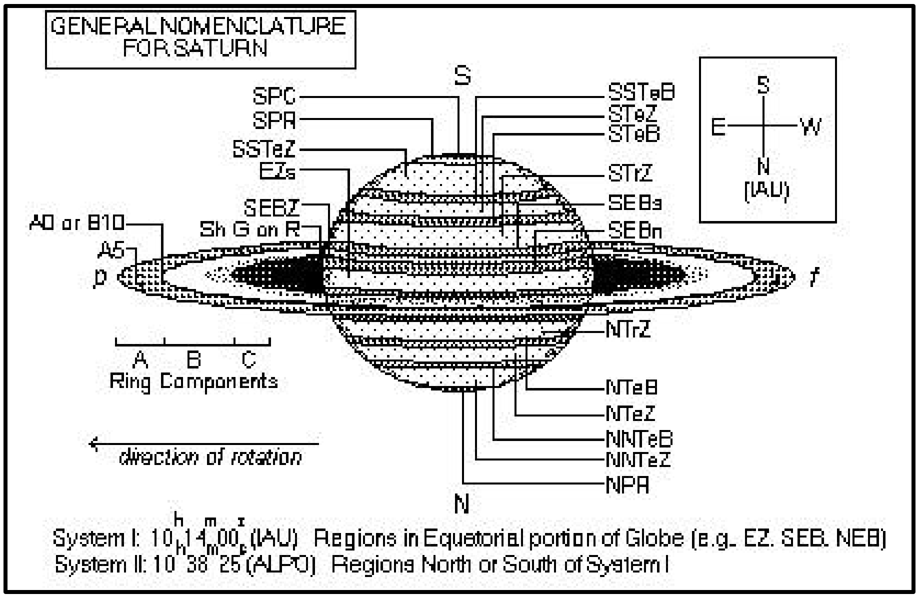

Figure 4. The schematic appearance of Saturn soon after opposition, where the numerical value of B is negative (Ð) when the Southern Hemisphere of the Globe and south face of the Rings is inclined toward Earth. Nomenclature appears for the major Globe and Ring features that may be visible with moderate apertures in good seeing. South is at the top, and features on Saturn's Globe move across the planet's disk from right to left in the normal inverted view (i.e., as seen in an astronomical telescope near culmination in the Earth's Northern Hemisphere without a star diagonal or other device that would reverse the image). The text discusses the Globe and Ring features shown here, with emphasis on the Southern Hemisphere of Saturn. Some minor features that are not depicted include the: South Polar Belt (SPB) encircling the SPR; South South South Temperate Belt (SSSTeB), immediately south of the SSTeZ; Shadow of the Rings on the Globe (Sh R on G); Terby White Spot (TWS), adjacent to the shadow of the Globe on the Rings (Sh G on R); and any intensity minima in several Ring components. The easternmost and westernmost extensions of the Rings are called the ansae.

mean intensity difference between the SSTeZ and NNTeZ of +0.46 is considered unimportant. The SSTeZ was described as a yellowish-white feature of consistent uniformity in intensity, at least until McAnally reported whitish spots from 1997 Jan 16-Feb 17. These white spots appeared most prominent using a W58 (green) filter, but they were also quite evident in integrated light, according to McAnally. Unfortunately, no other observers confirmed his reports.

- *South South Temperate Belt (SSTeB)* -- There was only one instance in which the SSTeB was seen during the 1996-97 Apparition. This belt was then described as a narrow, greyish feature, similar in appearance and prominence to what it had been in 1995-96.

- *South Temperate Zone (STeZ)* -- The yellowish-white STeZ was similar in mean intensity to the more southerly SSTeZ, and the STeZ varied an insignificant -0.43 mean intensity points from 1995-96 to 1996-97. Comparing the STeZ with its counterpart in the northern hemisphere (the NTeZ), both zones were essentially the same average intensity during the apparition. The STeZ showed uniformity in intensity during 1996-97, with no clearly-defined activity recorded.

- *South Temperate Belt (STeB)* -- The STeB was described in 1996-97 as greyish in color, extending uninterrupted across the globe from one limb to the other, and unchanged in mean intensity since 1995-96. The STeZ was suspected of being slightly darker than its northern hemisphere complement, the NTeB, and no activity was reported in the STeB in 1996-97.

- *South Tropical Zone (STrZ)* -- The dull yellowish-white STrZ was a meager -0.52 mean intensity points duller than the NTrZ during 1996-97, displaying about the same mean intensity reported in 1995-96. The STrZ remained stable in brightness and inactive throughout the observing season.

- *South Equatorial Belt (SEB)* -- The SEB was observed during 1996-97 as a single, greyish-brown feature with limited differentiation into SEBn and SEBs components, where "n" refers to the north component and "s" to the south component. When both the SEBs and SEBn were seen, observers described an intervening pale yellowish-white South Equatorial Belt Zone (SEBZ). With the exception of an isolated report of an Equatorial Band (EB) during 1996 November, the SEB was the darkest and most obvious belt in the southern hemisphere of Saturn in 1996-97, darker by a factor of -1.01

mean intensity points since 1995-96. The SEB showed a difference of -0.59 mean intensity points when compared with its northern counterpart, the NEB, during 1996-97. Activity in the SEB occurred periodically throughout the apparition, with sightings of dark spots and festoon-like projections from the extreme northern edge of the SEB extending into the EZs. When the diffuse bright ovals were first detected in the EZs in late 1996 September, the "f" (following) northern edge of the SEB (SEBn?) appeared fragmented and incomplete across Saturn's globe, with obvious interaction with the whitish features of the EZs. Parker submitted CCD images of the fragmented SEB and a bright EZs on 1996 Sep 25.

- *Equatorial Zone (EZ)* -- With Saturn's rings opening up following their edgewise orientation in 1995-96, the EZs was the portion of the EZ seen to greatest advantage during the 1996-97 Apparition. The EZ could still be viewed on either side of the ring plane during 1996-97, where the EZn denotes the region of the EZ between where the rings cross the globe and the NEB and the EZs is the portion of the EZ between where the rings cross the globe and the SEB. The bright yellowish-white EZs was only +0.77 mean intensity points brighter than it appeared in 1995-96, and the EZs was always the most brilliant zone on Saturn during the 1996-97 Apparition, lighter than Ring A and sometimes closely approaching the intensity of the outer third of Ring B. The elevated brightness of the EZs during the apparition was attributable mostly to the emergence of diffuse white spots, which were first reported to the ALPO Saturn Section on 1996 Sep 25. Convection processes uplift ammonia (NH_3) into Saturn's frigid outer atmosphere, where bright ice clouds condense and become visible as brilliant white spots. After the EZs spots were reported, an alert was issued by the ALPO Saturn Section so that observers could attempt CM transit timings to facilitate calculation of a rotation period for the features. The white spots of 1996-97 were not nearly as prominent as those witnessed in the EZ by Saturn observers during the great outbursts of 1960 and 1990 (evidence suggests that the really big storms tend to recur at these latitudes at intervals of one Saturnian year), nor were they as conspicuous as the EZn white ovals seen in 1994. Nevertheless, the 1996-97 spots were visible with most apertures, and observers found that they could see them best when using a green (W58) filter. The brilliant EZs spots also appeared to interact with the SEB, producing fragmentation along its north following (f) edge. Throughout 1996 September and October, the entire EZs-SEB region displayed a complex morphology (see CCD images accompanying this report; Figures 9, 10, 12, 13). As observers continued to monitor the progress of the white spots in the EZs through late 1996 October, the white spots gradually spread out along the zone, resulting in an EZs that remained elevated in brightness for the rest of the apparition. Using a very small number of CM transit timings, calculations suggested a rotation period of 10h 22m (drift rate in CM(I) longitude of roughly +11° per day), significantly slower than the established System I rotation period of 10h 14m 00s.

  The pale yellowish-white EZn was barely perceptible to observers during 1996-97 because of the rings crossing Saturn's globe at that latitude. Observers recorded a difference of -0.68 mean intensity points between the EZs and EZn during the apparition. Perhaps the shadow of the rings on the globe contributed to any diminished intensity of the EZn as well. Although it was apparent that the diffuse EZs white spots extended across Saturn's ring plane into the EZn, much of the EZ north of the rings was blocked from view.

- *The Equatorial Band (EB)* was suspected only once during 1996-97, described as a dark grey, poorly-defined linear feature running across Saturn's globe. A single intensity estimate suggested that the EB was a little darker in 1996-97 than in 1995-96 (by -1.09 mean intensity points). Thus, it would have been classified as the darkest belt on Saturn during 1996-97 if any confidence could be placed in this interpretation.

Northern Portions of the Globe

During the 1996-97 Apparition, the northern hemisphere of Saturn was virtually unchanged in mean intensity since 1995-96 (an increase of only +0.14 mean intensity points). From time to time during the observing season, observers suspected elusive, short-lived dusky features among Saturn's northern belts and zones. We have already discussed the white spots that were seen in the southern Equatorial Zone (EZs) of the planet and how these bright features probably extended into the EZn, contributing to elevated intensity of that zone north of the rings during 1996 September and October.

- *North Equatorial Belt (NEB)* -- The greyish-brown NEB during 1996-97 was always reported as a single feature undifferentiated into an NEBn and NEBs. Occasional dusky features, all barely perceptible to observers, were suspected along the NEB in favorable seeing during the apparition. On the basis of intensity estimates in 1996-97, the NEB was un-changed in mean intensity since 1995-96. A difference of only -0.59 in mean intensity between the SEB and NEB during the 1996-97 observing season was considered negligible. Aside from an isolated glimpse in 1996-97 of an apparent Equatorial Band (EB), the NEB was second only to the SEB in being the darkest belt on Saturn.

- *North Tropical Zone (NTrZ)* -- After the EZ and SEBZ, the yellowish-white NTrZ was the third brightest zone on Saturn's Globe in 1996-97. The NTrZ showed a mean intensity difference of only +0.47 from 1995-96 to 1996-97, and observers described it as a dull yellowish-white zone, uniform across the Globe from limb to limb.

- *North Temperate Belt (NTeB)* -- The light-greyish NTeB was very poorly defined and infrequently seen during the 1996-97 observing season. The intensity of the NTeB remained stable throughout 1996-97, and it was practically unchanged in intensity since the immediately preceding apparition.

- *North Temperate Zone (NTeZ)* -- In 1996-97 the yellowish-white NTeZ showed no meaningful change in intensity since 1995-96, nor was it easily detected in the Northern Hemisphere of Saturn for most of the apparition. The NTeZ and STeZ exhibited basically the same mean intensity during the 1996-97 observing season.

- *North North Temperate Belt (NNTeB)* -- Observers did not report this feature during the 1996-97 Apparition.

- *North North Temperate Zone (NNTeZ)* -- The dull yellowish-white NNTeZ was suspected only once during 1996-97, with a trivial mean intensity difference of -0.43 from 1995-96 to 1996-97. The SSTeZ in the South differed only by +0.46 mean intensity points from the NNTeZ, also a negligible difference.

- *North Polar Region (NPR)* -- The brightness of the dull yellowish-grey NPR was invariable throughout 1996-97, and the region showed a meager change of -0.51 in mean intensity since 1995-96. The North Polar Cap (NPC) nor North Polar Belt (NPB) were reported during the 1996-97 Apparition. Comparatively, the NPR and SPR were essentially the same intensity during 1996-97.

Ring Shadows

- *Shadow of the Globe on the Rings (Sh G on R)* -- The Sh G on R was seen by observers as a dark greyish-black feature on either side of opposition during 1996-97, with regular form. Any perceived departure from a true black (0.0) intensity was a result of poor seeing conditions or scattered light.

- *Shadow of the Rings on the Globe (Sh R on G)* -- Observers in 1996-97 described this shadow as a dark greyish-black feature south of the rings where they crossed the globe. Reported variations from an intrinsic black (0.0) condition were due to the same causes listed in the preceding paragraph.

Saturn's Ring System

This section of the 1996-97 Apparition report concerns studies of Saturn's ring system, including an ongoing comparative investigation of mean intensity data that has been a tradition in previous observing seasons. Views of the southern face of the rings were increasingly favorable during 1996-97 as the value of B increased.

- *Ring A* -- Considered as a whole, Ring A displayed a yellowish-white coloration throughout 1996-97, and a mean intensity change of +2.14 in mean intensity suggested a brightening of the Ring component since 1995-96. No observers reported Encke's Division (A5) at the ring ansae, nor did individuals apparently detect any other intensity minima in Ring A during the apparition.

  Observers did not report obvious outer and inner halves of Ring A in terms of intensity.

- *Ring B* -- The outer third of Ring B is the adopted standard of reference for the ALPO Saturn Intensity Scale, with an assigned value of 8.0. For the entire 1996-97 Apparition, this region of Ring B was white, remained stable in intensity, and was always the brightest feature on

Saturn's globe or in the Ring system, with the possible exception of brilliant EZs white spots (of mean intensity 8.5) in 1996 September and October. In 1996-97, the inner two-thirds of Ring B, which was yellowish-white in color and uniform in intensity, showed no change in brightness since the immediately preceding observing season. During 1996-97, Ring A was considered to be slightly brighter than the inner two-thirds of Ring B by most observers, but this difference was quite subtle as the mean intensity difference between Ring A and inner two-third of Ring B was only +0.50.

- *Cassini's Division (A0 or B10)* -- Most observers remarked that Cassini's division was rather difficult to see anywhere other than the ansae in 1996-97, and this same impression persisted even in excellent seeing. With a ring inclination during 1996-97 that was still quite small (values of B did not surpass -6°.20), views of Cassini's Division were far from optimal. Cassini's division was described as greyish-black during the 1996-97 Apparition, and it appeared darker by -3.35 mean intensity points since 1995-96, a change that was most likely due to the difference in angle of view from Earth since the 1995-96 edgewise apparition. Usually, a divergence from a totally black intensity for this feature is due to the scattering of light, unfavorable seeing, and other factors.

- *Ring C* -- Only two reports of a dark greyish Ring C at the ansae were received during 1996-97, and even then, observers were unsure that they had actually seen Ring C off the globe. The Crape Band (Ring C across the globe) was described as uniform in intensity and extremely dark grey in color. Partial coincidence of the Crape Band with the shadow of Ring C on the globe (when B and B' are approximately equal at small ring inclinations, as in 1996-97) yields a Crape Band that appears slightly darker than usual.

- *Terby White Spot (TWS)* -- The TWS is a brightening of the Rings occasionally seen immediately adjacent to the Sh G on R. In one instance, an observer suspected a bright TWS (intensity of 8.5) during 1996-97. The TWS is of no real importance, since it is almost certainly a spurious contrast phenomenon, not some intrinsic feature on Saturn. Nevertheless, it is considered worthwhile to try to determine if there is any connection between the visual numerical relative intensity of the TWS and the changing tilt of the ring system, as well as its visibility and brightness in color filters and variable-density polarizers.

- *Bicolored Aspect of the Rings* -- This phenomenon is a reported difference in color between the East and West Ansae when compared with W47 (Wratten 47), W38, or W80A (all blue) filters and W25 or W23A (both red) filters. Haas was the only observer during 1996-97 who noticed a bicolored aspect of the ring ansae. Table 5 lists the circumstances of Haas' observations, and the reader should note that the directions in the table refer to Saturnian or IAU directions, where west is to the right in a normally-inverted telescope image for an observer located in the northern hemisphere of the Earth with south at the top.3

UT Date and Time (entire observing period)		S	Tr	Filter BI	IL	Rd
1996 Oct 30	04:17-04:28	3.0	+4.5	E	=	=
1996 Nov 12	04:06-04:33	3.5	+3.5	W	=	=
1996 Nov 26	02:38-03:14	4.0	+4.0	W	=	=
1996 Dec 04	02:35-02:58	3.5	+2.5	E	=	=

NOTES: All observations are by Haas with a 31.8-cm (12.5-in.) Newtonian reflector at 321X. Seeing (S) is on the 0-10 ALPO Scale, and Transparency (Tr) is the limiting visual magnitude in the vicinity of Saturn. Under "Filter," BI refers to the blue W47 or W80A filters, IL to integrated light (no filter), and Rd to the red W25 or W23A filters. E means the East ansa was brighter than the W, W that the West ansa was brighter, and = means that the two ansae were equally bright. East and West directions are as noted in the text.

Table 5. Observations of the Bicolored Aspect of Saturn's Rings During the 1996-97 **Apparition**

To get a better understanding of the cause of the bicolored aspect of the rings, there remains a great need for observers to strive to conduct simultaneous observing programs which stress a systematic study of this phenomenon, among other projects. The greater the number of persons taking part in this effort, making independent, systematic visual estimates with color filters and doing CCD work and photography in the corresponding wavelengths, all at the same time, the better will be the chances of shedding some new light on this intriguing and poorly-understood phenomenon.

Saturn's Satellites

As in the last three preceding apparitions, no observers in 1996-97 contributed systematic visual estimates of Saturn's satellites using the methods outlined in *The Saturn Handbook* . Photoelectric photometry and systematic visual magnitude estimates of Saturn's satellites are strongly encouraged for future apparitions.

Simultaneous Observations

Several simultaneous, or near-simultaneous, observations of Saturn were submitted during 1996-97, where individuals worked independently of one another but observed at the same time and on the same date. As in the 1995-96 Apparition, the occurrence of simultaneous observations was entirely fortuitous, and the ALPO Saturn Section would like to receive reports from individuals who participate in a routine simultaneous observing effort. Simultaneous observations provide much-needed verification of ill-defined phenomena on Saturn's globe and in the ring system, greatly strengthening the confidence level in the interpretation of the data. Readers are urged to inquire about how to pursue simultaneous observations in future observing seasons.

Conclusions

Our analysis of the submitted observations of Saturn and its ring system during 1996-97 suggests that atmospheric activity remained moderate, somewhat consistent with the outcome of the two immediately preceding observing seasons. With Saturn's rings opening up more and more since the edgewise presentation of 1995-96, optimum views of the southern hemisphere of Saturn and south face of the rings are becoming possible. Our apparition reports, at least until the next edgewise ring presentation in 2009, will correspondingly stress observations of these regions of Saturn. As the reader can appreciate from the foregoing discussion that the highlight of the 1996-97 Apparition was the emergence of fairly prominent, diffuse white spots in the EZs during 1996 September and October. Observers tracked their evolution, which resulted in an EZs that remained brilliant throughout for the rest of the apparition. Other noteworthy features of the Saturn's southern hemisphere were the periodic festoons and dark projections associated with the SEB, plus intermittent white spots suspected in the SSTeZ near the end of the observing season.

We once again extend our sincere gratitude to all of the dedicated observers mentioned in this report who contributed data during 1996-97. Readers in the United States and abroad, who may not already be participating observers, are encouraged to submit their work to the ALPO Saturn Section, joining us as we further our international systematic study of the planet. Individuals just getting into lunar and planetary astronomy for the first time, including enthusiastic youngsters, are also encouraged to take advantage of the ALPO Training Program, but feel free to concurrently participate in our section. One of our responsibilities is to encourage development of special talents a particular novice observer might bring to the program.

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A Gallery of Saturn Images

Unless otherwise stated for these illustrations: Telescope types are as given in Table 2; Seeing (S) is given on the 0-10 ALPO Scale, where 0 is the worst possible and 10 is perfect; Transparency (Tr) is the limiting naked-eye visual magnitude in the vicinity of Saturn; CM(I) is the central-meridian longitude in rotational system I (844û.3/day, applying to the NEBs, EZ, and SEBn); CM(II) is the same in rotational system II (812û.0/day, applying to the remainder of the Globe); B is the saturnicentric latitude of the Earth; B' is the saturnicentric latitude of the Sun; Globe is the apparent diameter of the Globe in arc-seconds (equatorial and polar); and Rings is the apparent major and minor axes of the Rings in arc-seconds. The source of ephemerides was The ALPO Solar System Ephemeris (1996 and 1997 editions), except for B', which was taken from the Astronomical Almanac for the same years. Saturnicentric south is at the top, with celestial east (following) to the right, unless otherwise stated. The sky background has been made black for all illustrations when it was not already so, and contrasts have been exaggerated.

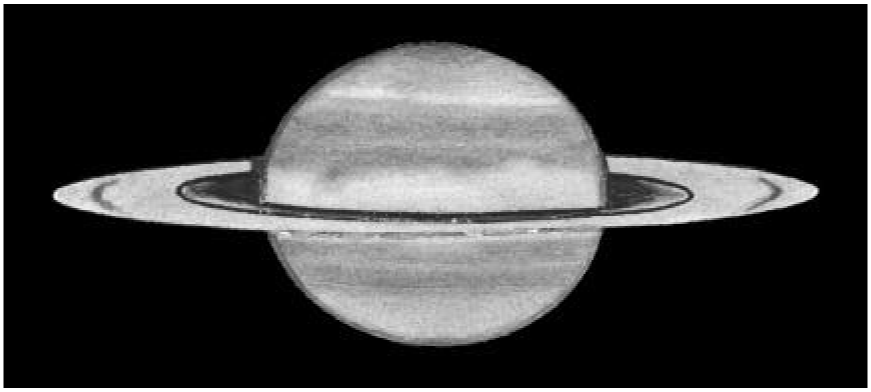

Figure 5. Saturn drawing: 1996 Sep 02, 05h33m UT. P. Plante. 20.3-cm (8.0-in) SC, 4165, Integrated Light. S = 6.5, Tr = +1.5. CM(I) = 313°.6, CM(II) = 238°.9. B = -5°.30, B« = -4°.31, Globe = 19".3 5 17".2, Rings = 43".7 5 4".0. Northern edge of SEB shows irregularities; bright EZs.

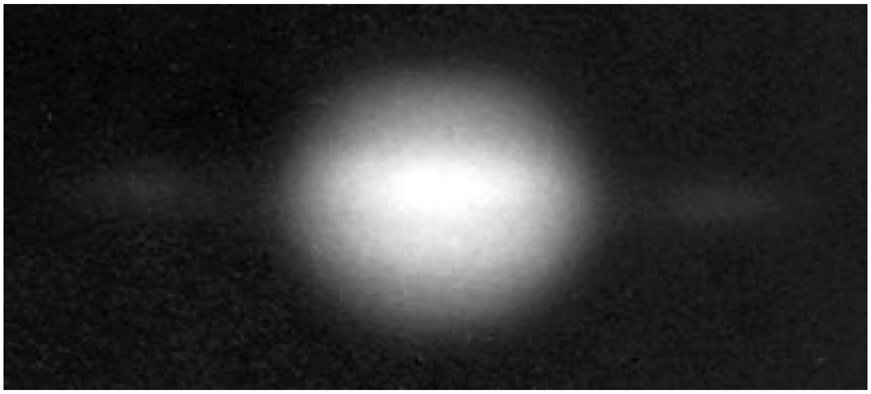

Figure 6. Saturn image. 1996 Sep 20, 04h30m UT. F.J. Melillo. 20.3-cm (8.0- in) SC, CCD Camera, Integrat-ed Light. S = 8.0, Tr = +4.5. CM(I) = 355°.6, CM(II) = 235°.8. B = -4°.68, B « = -4°.58, Globe = 19".5 5 17".4, Rings = 44".1 5 3".6. Bright EZs quite apparent in CCD image.

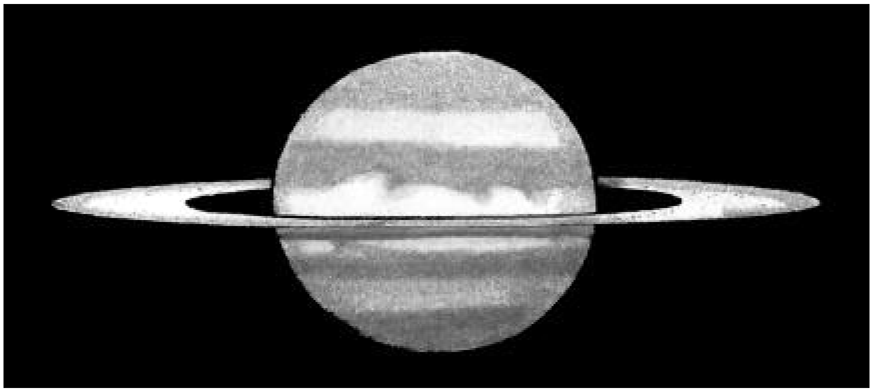

Figure 7. Saturn drawing. 1996 Oct 06, 19h20m UT. D. Niechoy. 20.3-cm (8.0-in) SC, 2255 , Integrated Light. S = 2.5, Tr = +2.5. CM(I) = 346°.9, CM(II) = 235°.8. B = -4°.09, B« = -4°.83, Globe = 19".4 5 17".4, Rings = 44".1 5 3".1. Considerable activity along northern edge of SEB; brilliant EZs.

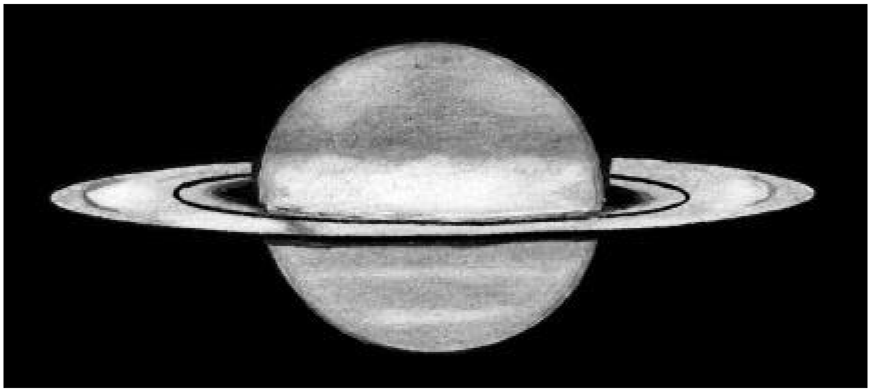

Figure 8. Saturn drawing. 1996 Oct 16, 03h50m UT. P. Plante. 20.3-cm (8.0-in) REF, 3755, Integrated Light. S = 5.5, Tr = +4.0. CM(I) = 325°.6, CM(II) = 271°.9. B = -3°.78, B« = -4°.97, Globe = 19".3 5 17".3, Rings = 43".9 5 2".9.

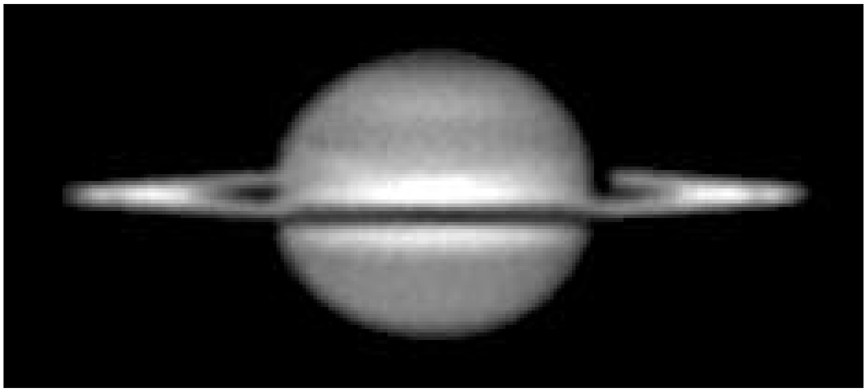

Figure 9. Saturn image. 1996 Oct 28, 01h11m UT. D.C. Parker. 40.6-cm (16.0-in) NEW, CCD Camera, Integrated Light. S = Good, Tr = Good. CM(I) = 284°.1, CM(II) = 206°.5. B = -3°.45, B« = -5°.15, Globe = 19".1 5 17".1, Rings = 43".4 5 2".6. Bright EZs.

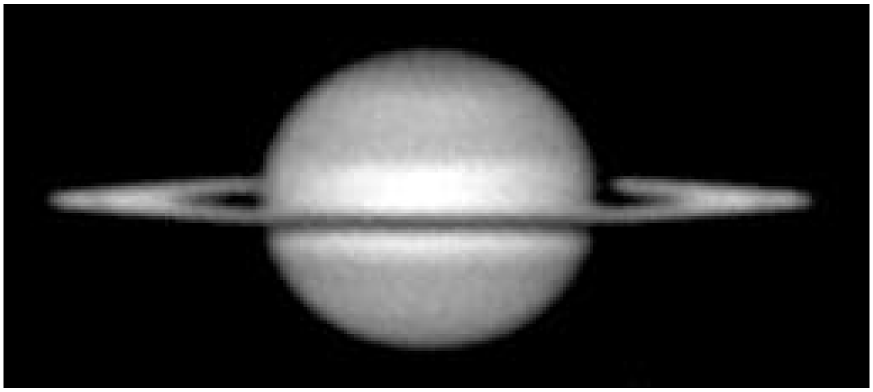

Figure 10. Saturn image. 1996 Oct 29, 01h08m UT. D.C. Parker. 40.6-cm (16.0-in) NEW, CCD Camera, Integrated Light. S = Good, Tr = Good. CM(I) = 046°.6, CM(II) = 296°.8. B = -3°.42, B« = -5°.16, Globe = 19".1 5 17".1, Rings = 43".4 5 2".6. Bright EZs.

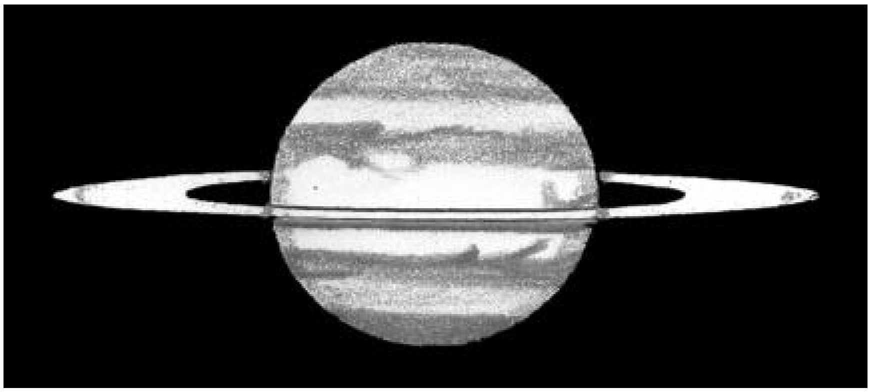

Figure 11. Saturn drawing. 1996 Nov 22 , 16h54m UT. D. Niechoy. 20.3-cm (8.0-in) SC, 2255, Integrated Light. S = 2.5, Tr = +2.5. CM(I) = 344°.0, CM(II) = 157°.8. B = -3°.04, B« = -5°.53, Globe = 18".5 5 16".5, Rings = 41".9 5 2".2. Activity along northern edge of SEB; activity also apparent along southern edge of NEB; bright EZs.

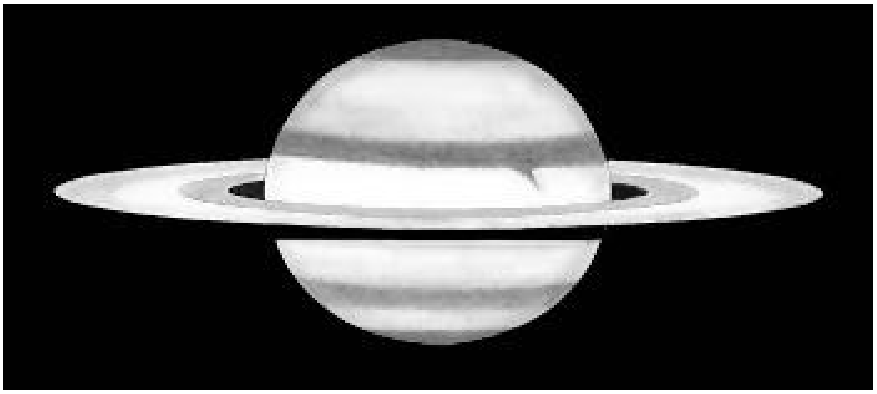

Figure 12. Saturn drawing. 1996 Dec 06, 01h30m UT. C.E. Hernandez. 20.3-cm (8.0-in) NEW, 1795, Integrated Light. S = 7, Tr = +5. CM(I) = 101°.5, CM(II) = 203°.9. B = -3°.04, B« = -5°.73, Globe = 18".1 5 16".1, Rings = 41".0 5 2".2 . Festoon-like projection from northern edge of SEB.

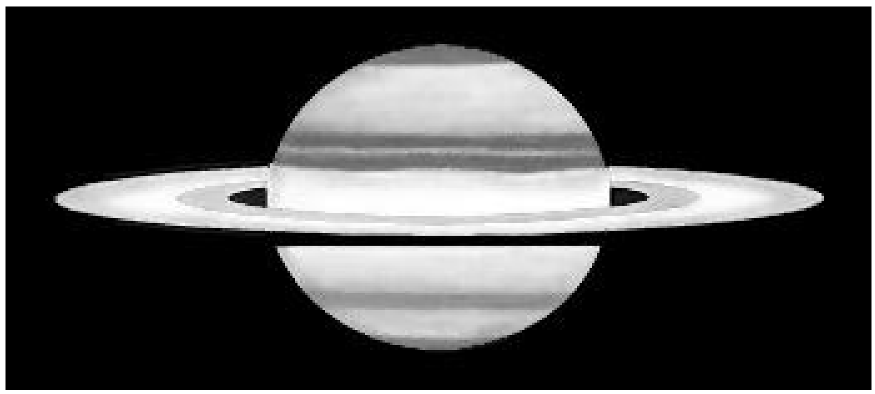

Figure 13. Saturn drawing. 1996 Dec 09, 01h30m UT. C.E. Hernandez. 20.3-cm (8.0-in) NEW, 1795, Integrated Light. S = 5.5, Tr = +6. CM(I) = 114°.2, CM(II) = 119°.6. B = -3°.06, B« = -5°.78, Globe = 18".0 5 16".1, Rings = 40".8 5 2".2. Bright EZs, SEBs and SEBn visible with SEBZ separating the two components.

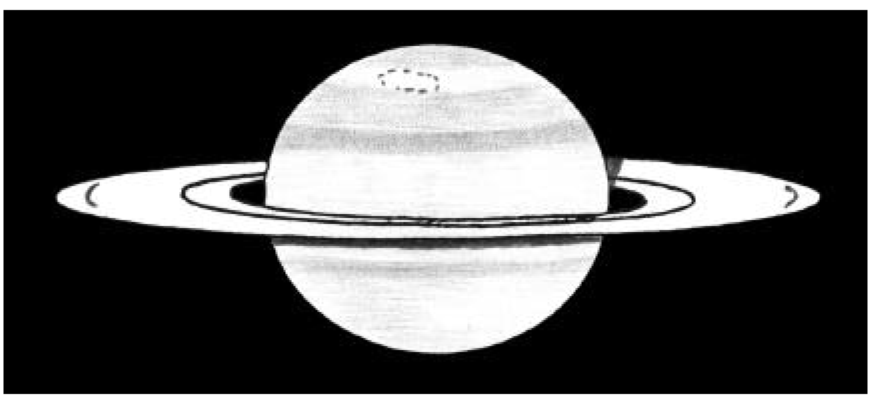

Figure 14. Saturn drawing. 1997 Feb 05, 00h50m UT. J.W. McAnally. 11.4-cm (4.5-in) NEW, 2725, Integrated Light, W11, W21 Filters. S = 8.5, Tr = +5.0. CM(I) = 093°.2, CM(II) = 026°.3. B = -4°.76, B« = -6°.64, Globe = 16".5 5 14".9, Rings = 37".2 5 3".1. Suspected bright spot in SSTeZ; best view using W11 filter.

Illuminated Extent:

A Telltale Measure of an Inferior Planet's Disk

By: Mark Gingrich, Eastbay Astronomical Society

Abstract

A descriptive parameter dubbed "illuminated extent" is proposed, defined as the total solid angle subtended, from an astronomer's eye view, by the illuminated portion of an object. A celestial body exhibiting wide variance in both phase and angular size – an inferior planet, primarily – is well-characterized by this parameter, for its peak value ("greatest illuminated extent" or GIE) denotes when the luminous image maximally covers a telescope's focal surface, a prime viewing circumstance. The relevance of a kindred apparitional occurrence, greatest brilliancy, also is discussed.

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Definition and Justification

Forecasting the ideal date to inspect a superior planet [i.e., one whose orbit lies outside the Earth's. Ed.] has long been a simple matter: It is best spied at opposition. That, of course, is when the orb reigns above the horizon throughout the evening, subtends its largest (or nearly so) angular width, and when it reveals a fully sunlit disk – a welcome concurrence of optimal aspects for Earth-bound planet watchers.

But with the inferior planets [those that orbit between the Earth and the Sun. Ed.], these very same aspects are never simultaneously favorable. It is by fiat of the Solar System's arrangement and an unavoidable dictate of geometry that both Mercury and Venus span their widest angular diameters near inferior conjunction, just as their disks are minimally illuminated, if not altogether unlit. Conversely, when these planets realize full phase at superior conjunction, angular diameters are at low ebb. [Conjunction occurs when the planet, the Sun, and the Earth are closely aligned; inferior conjunction pertains when the planet lies between the Earth and the Sun; superior conjunction, when the Sun is between the Earth and the Planet. Ed.]

Now toss elongation into the mix. [Elongation is the angular distance between the planet and the Sun as seen from the Earth. Ed.] Alas, inopportune timing again befalls us, for when either angular size or phase is most propitious, the Sun drowns the planet in glare. That leaves one seemingly optimal configuration – greatest elongation. Yet whenever an inferior planet camps at maximum angular separation from Sol, we must settle for well-below-maximum values of apparent diameter and phase.

From our perspective, then, the sunward planets' cyclical aspects appear to be perfectly ill-timed, a situation that will remain forever so. Given this predicament, when is the "best" moment to view an inferior planet? Which instant during a Mercur-ian or Cytherean apparition is akin to opposition, in the sense of the joint effect of angular size, phase, and elongation being most advantageous?

The paramount viewing date is not necessarily at greatest elongation, oddly enough. As observers, we want a planet's illuminated region to project over the largest spread of retina possible for a given magnification. Or, equivalently, we wish the visible image to blanket the greatest number of CCD pixels for a given effective focal length. As it turns out, this optimal circumstance can be defined for every apparition: the instant of "greatest illuminated extent" (GIE).

Let's give illuminated extent a quantitative definition. Simply, it is the total solid angle subtended, from the observer's vantage point, by the celestial object's sunlit portion. (Think of it as the apparent disk's illuminated surface area; a square arcsecond is a convenient measurement unit.) If an orb of negligible oblateness has angular diameter d and illuminated fraction k, the illuminated extent (IE) is given by:

$$(1)\quad IE = \frac{\pi k d^2}{4}$$

Thus IE is readily computed upon looking up values for d and k in, for example, *The Astronomical Almanac (USNO, 1999, E52-E63)*. An equivalent formula can be used as well, this one employing distances between the three involved celestial bodies:

$$(2)\quad IE = \frac{\pi s^2 (r + \Delta + R)(r + \Delta - R)}{4r\Delta^3}$$

Here, s is the planet's semidiameter at 1 astronomical unit (Mercury: 3".36, Venus: 8".41); r, R, and D are the planet-Sun, Earth-Sun, and Earth-planet distances in astronomical units, respectively. [Editor's Note: One astronomical unit, or AU, is the mean distance from the Earth to the Sun; 149,597,870 km.]

For all practical purposes a superior planet's opposition coincides with its GIE; thus the event does not distinguish itself for Earth's outer siblings. By contrast, happenstances of GIE for Mercury and Venus are independent of conjunctions and greatest elongations; for these planets GIE merits recognition as a singular apparitional milestone. But despite a similarity of geocentric phenomena, the timing of GIE relative to conjunctions and greatest elongations is different for each inferior orb, as is made plain in the accompanying figures.

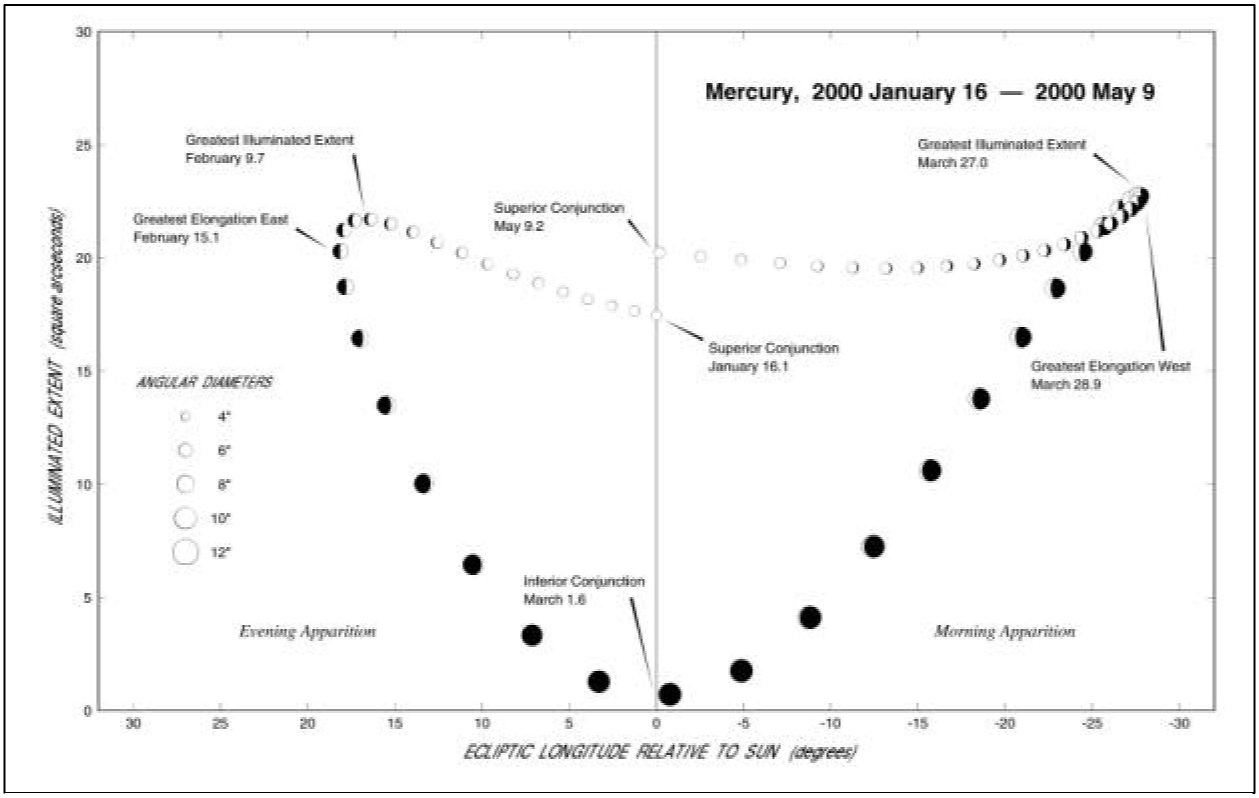

Figure 1: Mercury's illuminated extent is plotted at 0 hours UT [Universal Time] every two days over one synodic cycle – two apparitions – versus the component of solar elongation along the ecliptic. Phase and relative disk size also are shown. The curve's roughly heart-shaped pattern is similar across synodic cycles, yet the locations of GIE differ capriciously with each.

One typical Mercurian synodic cycle is sketched in Figure 1, a plot of illuminated extent versus the ecliptic component of elongation. Note the steep drop in IE toward inferior conjunction (2000 Mar 01); IE later ascends, then it levels off between greatest elongation west (Mar 28) and superior conjunction (May 09), the quantity of sunlit square arcseconds holding steadfast on the "back side" of Mercury's apparent orbit. But this orbit is famously ovate. (Of the planets, Mercury has the second-highest eccentricity.) Hence, the Earth-Mercury distance and hence, Mercury's angular width varies flagrantly from one cycle to the next for any one particular phase angle. What this means is, over the long haul, the IE curve might peak anywhere along a wide range on that high "plateau," perhaps a scant one week from superior conjunction, or within a few days of, before or after, greatest elongation. (Figure 3 shows the actual distribution of elongation angles at GIE.) The event appears fickle. But more often than not, GIE lands on the wider angular separations, closer than a week from greatest elongation in 72 percent of Mercury's apparitions.

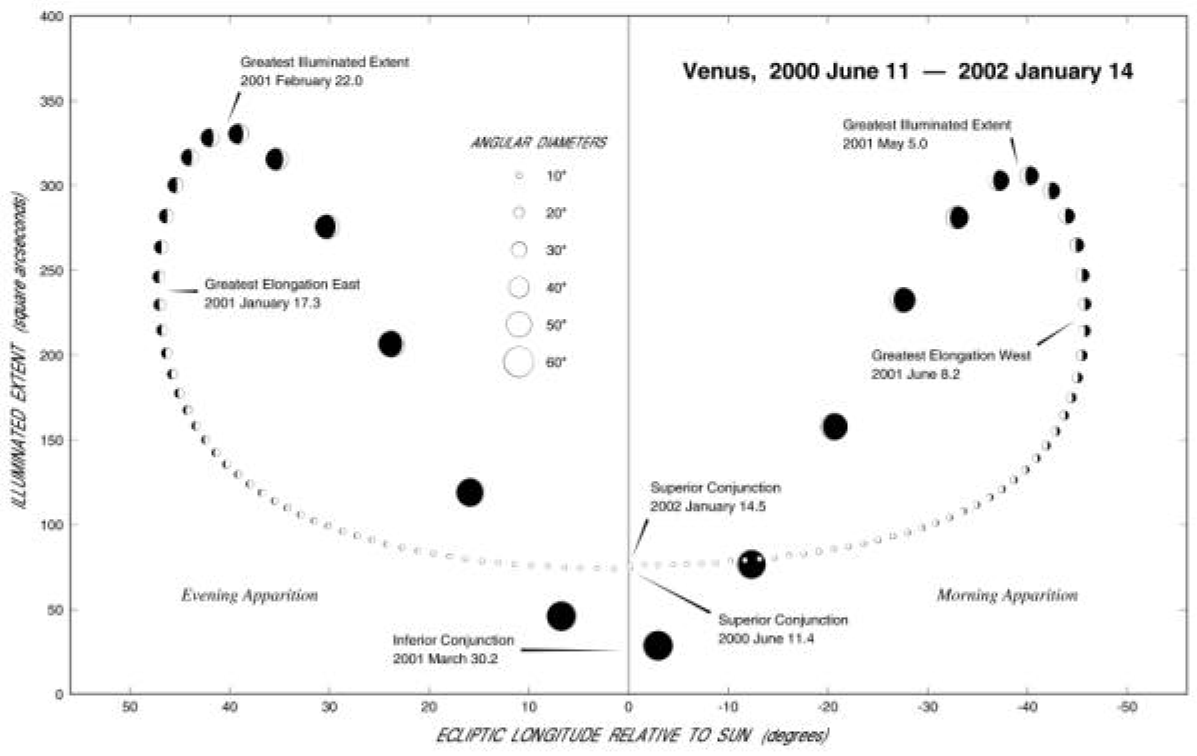

Figure 2: In a like manner as Figure 1, Venus's illuminated extent is plotted at six-day intervals. The orbit brings it both closer and farther away than Mercury, so the resulting plot departs radically in shape from that of the innermost planet. Of particular interest are the short-lived peaks of illuminated extentÑthe most auspicious viewing times .

Venus, on the other hand, is a model of consistency. Its GIE recurs like clockwork, midway in time between inferior conjunction and greatest elongation, five weeks distant from each, with the planet perched 40 degrees from Sol, exposing a 27-percent-sunlit crescent that is 39 arcseconds from cusp to cusp. (These nominal values waver by the merest amounts with each GIE, a monotony attributable to Venus's almost-circular orbit. Indeed, any meager deviations are chiefly a side effect of the more eccentric orbit of Earth.) The IE curve (Figure 2) is forged into its characteristic "moose antler" shape by Venus's more pronounced distance extremes: The backside plateau straddling superior conjunction becomes squat; moreover, during the swift dash toward and away from inferior conjunction, Venus's angular diameter expands then shrinks apace, and this, convolved with rapid change in the fraction of its disk illuminated, gives rise to conspicuous short-term peaks in illuminated extent.

There are two main points that a planetary observer should glean from these figures. (1) The period commencing a few days prior to greatest elongation west [for a morning apparition], through superior conjunction, until several days beyond greatest elongation east [in an evening apparition], roughly an eleven-week stretch, keeps Mercury within the top 25 percent of its illuminated-extent range. The planet shines at its eyeful best on the date of GIE, obviously, yet illuminated extent is not unfavorable over that entire interval. However, when solar interference is weighed, the wider elongations near the ends of the plateau are preferable. (2) For Venus, the five-week spell anchored to GIE – skewed such that three weeks of which are on the side of greatest elongation, two weeks are toward inferior conjunction – is the "prime time" viewing opportunity.

Wherefore Greatest Brilliancy?

A parenthetic word needs to be said about a related apparitional event. If either equation (1) or (2) is scaled by the factor 1/r2 (r being the planet's heliocentric distance), then the moment when the maximum value is reached flags the object's so-called greatest brilliancy (*HMNAO*, 1961, 209). Venus's

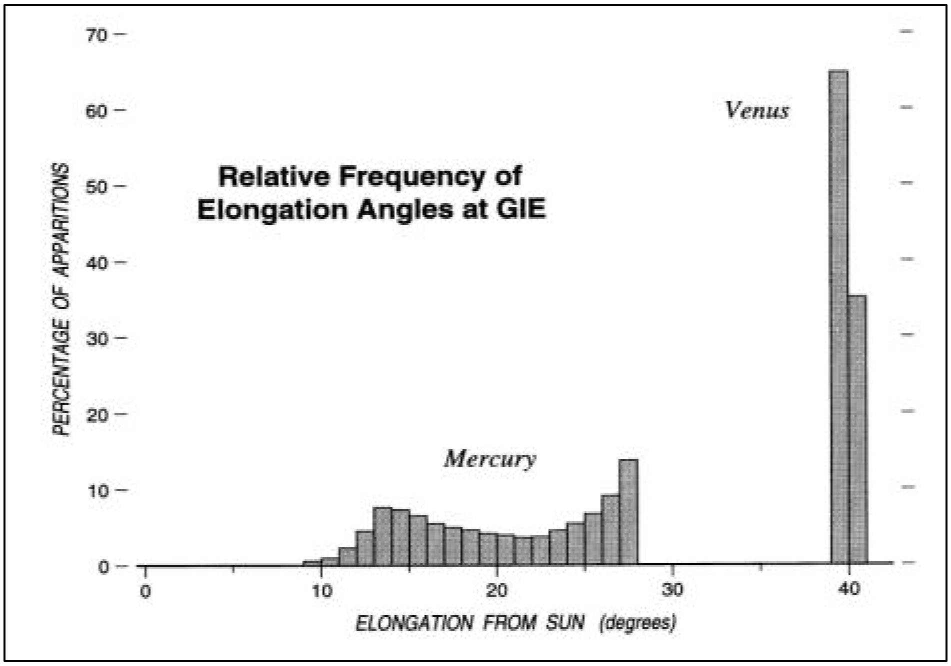

Figure 3: The GIE event would be of little interest to observers if it often occurred too near the Sun, elongation-wise, as often happens with Mercury's greatest brilliancy. This histogram proves otherwise, a tally made over each inferior planet's synodic "supercycle" – 217 years for Mercury, 243 years for Venus [Meeus, 1997, 225-226]. Mercury's elongation at GIE exhibits wide variance, but still the mean value is comfortably distant at 20°.4. Venus's GIE is more tightly constrained, with a mean elongation of 39°.7.

low-eccentricity orbit implies a nearly constant 1/r2; as a consequence, greatest brilliancy and the pinnacle of illuminated extent are almost simultaneous – always less than a half-day apart, in fact. Tight pairings of these maxima also occur for Mercury, but not consistently so, as its elongated orbit may conduce a gap of up to seven weeks between greatest brilliancy and GIE.

It is a misconception to think that greatest brilliancy marks the instant of brightest visual magnitude. Such would be rigorously true if planets exactly mimicked lambertian surfaces, reflecting sunlight uniformly in all directions. The fact is, they don't. Formulas for prognosticating planetary magnitudes have long been codified to take into account reflectivity change as a function of phase angle (Harris, 1961, 276-288), a complication that does not factor into the expression for "brilliancy." Hence greatest brilliancy and the peak predicted magnitude are distinct moments, differing by up to three days for Venus, and sometimes weeks apart for Mercury. (Furthermore, the magnitude formulas ignore temporal variations unrelated to phase. So the observed magnitude does not, in general, agree precisely with the value prophesied in a planet's physical ephemeris.)

Curiously, greatest-brilliancy dates are listed only for Venus in *The Astronomical Almanac*. The old (1961) edition of the *Explanatory Supplement* confesses as to why Mercury gets short shrift (*HMNAO*, 1961, 209):

In the case of Mercury the dates of greatest brilliancy occur after greatest elongation west, and before greatest elongation east; but Mercury is not always readily observable at the time of its greatest brilliancy and this phenomenon is not tabulated.

	Illuminated Extent (square arcseconds)	
Object	Minimum	Maximum
Mercury	0.0	22.8
Venus	0.0	348
Mars	9.6	495
Jupiter	683.0	1820
Saturn*	160.0	650
Uranus	8.7	12.8
Neptune	3.6	4.2
Pluto	0.003	0.010
Moon	0	3,180,000

* Allows for the illuminated extent of both A and B rings, edge-on and at maximum tilt, respectively, in addition to the globe.

Table 8: Illuminated-Extent Ranges for Solar System Objects

Planet		Date/Hour (UT)			Elongation From Sun (degrees)	Visual Magnitude	Angular Diameter (arcsec)	Illuminated Fraction	Illuminated Extent (sq. arcsec)
Mercury	2000	Feb	09	17	16.7 E	-0.9	6.2	0.727	21.7
		Mar	27	00	27.7 W	+0.3	7.7	0.484	22.8
		May	17	20	10.4 E	-1.4	5.4	0.906	20.6
		Aug	08	21	13.6 W	-1.1	5.7	0.815	20.8
		Oct	08	23	25.4 E	+0.1	7.0	0.559	21.8
		Nov	17	14	19.1 W	-0.6	6.4	0.677	21.5
	2001	Jan	24	12	17.6 E	-0.8	6.3	0.705	21.7
		Mar	08	16	27.3 W	+0.2	7.5	0.513	22.8
		May	04	08	12.5 E	-1.2	5.6	0.857	20.9
		Jul	25	00	13.1 W	-1.2	5.6	0.835	20.7
		Sep	21	10	26.4 E	+0.2	7.2	0.536	21.9
		Nov	02	05	18.0 W	-0.7	6.2	0.699	21.4
	2002	Jan	09	03	18.7 E	-0.7	6.4	0.683	21.7
		Feb	18	19	26.4 W	+0.1	7.3	0.541	22.6
		Apr	19	19	13.4 E	-1.2	5.7	0.828	21.1
		Jul	10	08	12.3 W	-1.2	5.5	0.860	20.5
		Sep	03	11	27.1 E	+0.3	7.4	0.510	22.0
		Oct	18	00	17.0 W	-0.8	6.1	0.722	21.3
		Dec	24	13	19.8 E	-0.6	6.5	0.661	21.7
Venus	2001	Feb	22	01	40.4 E	-4.6	39.2	0.274	331.1
		May	05	00	39.3 W	-4.5	38.6	0.263	306.5
	2002	Sep	26	07	39.3 E	-4.6	40.0	0.256	321.2
		Dec	06	20	40.1 W	-4.7	40.5	0.265	341.4

Table 2: Instances of Greatest Illuminated Extent, 2000 - 2002

In other words, Mercury's greatest brilliancy on occasion falls too near its difficult-to-observe superior conjunction.

As presently defined, greatest brilliancy is an idealized concept; it is not an immediately detectable event; it is usually noted for just one planet, an ad hoc phenomenon. Instead, why don't almanacs report the dates of peak predicted magnitude ("greatest luminosity"), which is what greatest brilliancy is often mistakenly thought to signify?

Summary

Venus, at its closest, attains a greater angular breadth than does Jupiter at opposition. But when both are at GIE, Jupiter casts a gleam with a five-fold greater areal swath onto the observer's retina (Table 1). This is one of Jupiter's traits that makes it a more compelling sight in a telescope. And this is why illuminated extent is a more telling indicator of "viewability" than angular-width or fraction-illuminated numbers alone. IE serves as a direct appraisement for how much can be seen. Wouldn't it make sense, then, if sky almanacs and planetarium software adjoined illuminated-extent values to their ephemerides? Wouldn't the utility of celestial calendars and observers' handbooks be enhanced, if only slightly, by juxtaposing the dates of greatest illuminated extent with those of conjunctions and greatest elongations? And if the frequently misconstrued phenomenon called greatest brilliancy warrants continued mention in the astronomical annuals, then why not also GIE? The latter event, I would argue, is of more practical significance to observers.

It may take a while for the notion of illuminated extent to catch on, if it ever does. Meantime, Table 2 is offered as a stopgap reference, a tally of each instance of GIE over the next three years.

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Index to Volume 41 of *The Strolling Astronomer,* Journal of the Association of Lunar and Planetary Observers

Index compiled by Michael Mattei

Publication Data

Issue Number:	1, January, 1999	pp. 1-48
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(Abbreviations: I. = Issue, IBC = Inside Back Cover, OFC = Outside Front Cover)

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Thrift-Store Computers versus Supercomputers

By: R. B. Minton, Acting Coordinator, ALPO Instruments Section

The March, 1987 issue of *Sky & Telescope* published "Astronomical Software Benchmarks" containing a few short programs in BASIC to test the speed and computational accuracy of existing computers (Kelso, 1987). These are called "Savage" benchmarks, and measure the time required to reach the correct answer of 2500. For example, an 8-MHz 8086 central processing unit (CPU) required 119 seconds, an 8 MHz 80286 needed 54 seconds, and a Cray X-MP/24 supercomputer did it in 0.7463 seconds (but in Fortran).

Since 1987, we now have new models -- 386, 486, Pentium, Celeron, to mention only Intel's CPUs -- other brands are comparable. One now reads of benchmarks to test business and game applications with no mention of computational accuracy or of the original Savage benchmark. How do these newer CPUs rate using the Savage benchmark?

I have tested the following CPUs using the double-precision Savage program with QBasic, and here are the results:

CPU Type/Name	Speed MHz	Benchmark sec
8086	5	215
8088	5	192
8088 Turbo	8	74
80286	12	34
80386 SX	16	19.3
80486 DX	25	14.5
80486 DX	33	6.9
80486 DX	66	3.7
Celeron	366	0.522
Celeron	433	0.422

I have not tested the Pentium II or III CPUs in the 500-800 MHz range, but they should benchmark in the range of 0.3-0.2 seconds. I invite readers who might own these faster computers to make their own tests and write me with their results. It is necessary to add an extra FOR-NEXT outer loop to repeat the test 1000 times to obtain timing accuracy; so if it took 222 seconds the correct answer is 0.222 sec.

These tests also reveal that anyone who owns a Celeron or equivalent CPU with a speed of 300 MHz or more is the proud owner of a supercomputer! Today's definition of a supercomputer may have changed upward from the 1980s definition used by Mr. Kelso; but I like the thought of owning a supercomputer. This distinction may be a moot point, but such a computer is nevertheless a "classical supercomputer" and is very fast for astronomical applications.

Now comes the tearful news -- a computer that cost $1,000 in the early 1990s (a 386 or 486) can now be found in thrift stores for $10 or less. In recent trips to Albuquerque, New Mexico, I have found dozens of 286/386/486 computers for $5 to $20 -- complete with floppy drives, hard drives, sound cards, and a few with CD-ROM drives.

This is a great opportunity for the amateur to beef-up his computing power. If you are like me, you always need another computer for another job at hand -- call this multi-tasking. I like to dedicate a different computer to each and every requirement, using one with just enough power for the task. Such tasks might include grabbing or manipulating CCD imagery, running your favorite star chart or planetarium graphics program, computing look angles for a Dob, sending a fax, connecting to the Internet, storing data from another instrument (e.g., photometer or radio telescope), computing orbits, running burglar alarms, doing statistics, storing observing data, writing letters, running the observatory; the list is almost endless.

Even the lowly 8088 processor can output pulses from 10 Hz to 10 KHz and drive a stepper motor. To me, a computer is a valuable astronomical adjunct and tool.

A trip to your local thrift store can fill these needs and provide a good home to an otherwise lost and orphaned computer. One will develop a good eye for spotting a functional computer, but even the bad ones are useful for parts. Quite often, a computer that is scruffy-looking will be the least expensive, but functional. The same is true for one with an empty bay because of a missing disk drive.

It is also fun and educational to assemble working computers from parts, or resurrect a dead computer. (Chances are good that you'll get a working computer since one big reason for donating a computer is to get a $1,000 tax donation write-off for something now worth only $10). The thrift store I use even has a working CPU, monitor, and keyboard on a bench so the buyer can test any of these three components.

If there is sufficient reader interest, I can summarize my experiences in swapping-out boards, drives, and other parts to revive or optimize a thrift store computer. The first reference (Glover and Young, 1992) is an excellent first step in learning. It contains power-up audio/video error codes, motherboard switch settings, 73 pages of hard drive specifications, and much more. My `92 copy was given to me in `93 so I don't know its current availability or cost. Readers may feel free to write me with questions, and I will answer them as best I can, but please include a SASE.

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Kelso, T.S. (1987) "Astronomical Software Benchmarks", *Sky & Telescope*, pp. 309-310 (March).

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New Books Received

Comments by: Jose Olivarez, ALPO Book Review Editor

The Deep Sky, An Introduction
By Philip S. Harrington.

Sky Publishing Corporation,
49 Bay State Road, Cambridge, MA 02138
1997, 272 pages, $24.95, paperbound
ISBN 0-9333346-80-8

This book is an excellent reference for anyone who owns a telescope or binoculars but doesn't know what to look for amid the stars and constellations. It describes the best double and multiple stars, open and globular clusters, nebulae and galaxies, and then explains how to find them. Detailed descriptions of more than 300 deep-sky objects are included and 100 of these are illustrated by black-and-white photographs. "The book," says the author, "is much more than just another observing handbook." It is his hope that it will not only serve to inspire the reader, but also to train the reader to become a deep-sky observer. And true to his goal, Mr. Harrington offers substantial guidance towards making the reader a deep-sky observer. To ease the training, he also includes 36 full-page star charts that permit the finding and identification of all the major deep-sky objects described in the book. The sky charts were especially printed for this volume and occur as a *Star Atlas* at the back of the book.

This is one of the better deep-sky observing handbooks available today because it is both inspiring and engagingly written.

A Sky Watcher's Year
By Jeff Kanipe

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211
1999, 204 pages, $19.95, paperbound
ISBN 0-521-63405-9

Through 52 essays, *A Sky Watcher's Year* guides the reader to celestial events and phenomena that occur and are visible to the naked-eye or binoculars for each week of the year. Covering both the northern and southern hemispheres, this book helps readers find many of the more prominent deep-sky objects and constellations and explains how and when to observe the annual meteor showers.

The appendix of this book is also useful for long range planning because it includes information on the general location of the planets through 2010 and a listing of all forthcoming total and annular solar eclipses through 2024.

Jeff Kanipe is a science journalist who knows his astronomy and night sky well. So, *A Sky Watcher's Year* is recommended. It is an authoritative guide to the celestial sights available during each week of the year.

The Monthly Sky Guide, 5th Edition
By Ian Ridpath and Wil Tirion

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211
1999, 64 pages, $16.95, paperbound
ISBN 0-521-66771-2

Over 2000 stars are visible to the unaided eye at any one time under the clearest conditions, but most are faint. Only a few hundred are bright enough to be prominent to the naked eye, and these are plotted on the monthly sky maps in this book. The authors say that the brightest stars of all act as signposts to the rest of the sky and that it is a welcome fact that you need to know only a few dozen stars to find your way around the sky with confidence.

With 50 clear star maps and guidance notes for exploring the sky, *The Monthly Sky Guide* introduces the reader to the stars month by month without the need for optical aid. This is a large and attractive paperback book.

Meteorites and Their Parent Planets, Second Edition
By Harry Y. McSween, Jr.

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211
1999, 310 pages, $29.95, paperbound
ISBN 0-521-587514

Meteorites and Their Parent Planets provides an engrossing overview of the study of extra-terrestrial materials. This second edition has been thoroughly revised and describes the nature of meteorites – where they come from, and how they get to earth. The first edition was popular with meteorite collectors and amateur astronomers because the writing is accessible; and because Dr. McSween also gives equal emphasis to the meteorites and to what has been learned about the asteroids, comets, and planets from which they have come.

In this edition, all the illustrations have been updated and improved, many sections have been expanded and modified, and a new final chapter on the importance of meteorites has been added.

Meteorites and Their Parent Planets is an authoritative and readable account of the current state of meteoritics and is one of only two books on meteorites recommended by the Curator of Meteorites at the Smithsonian's Museum of Natural History.

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