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Journal of the Association of Lunar & Planetary Observers

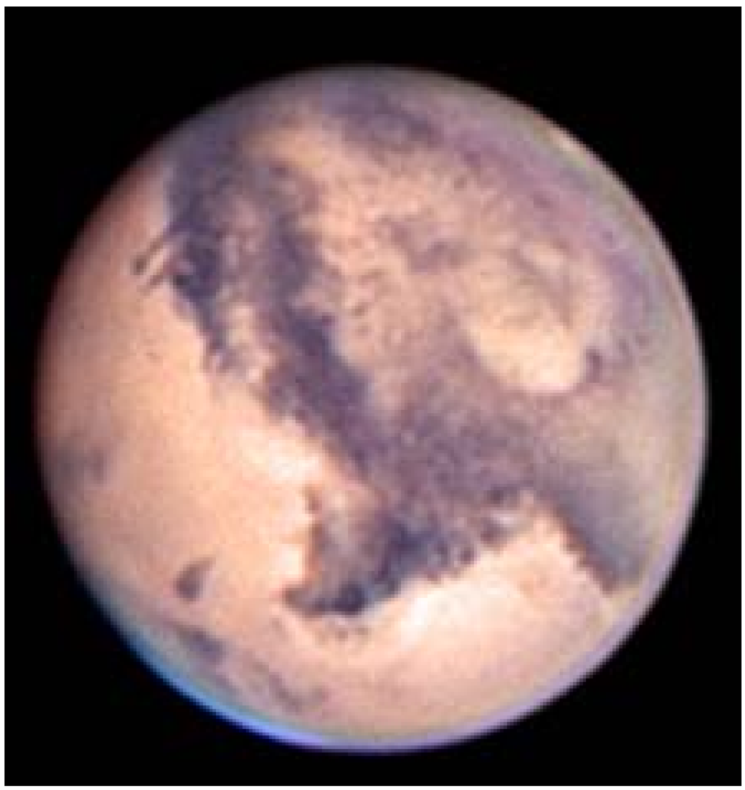
The Strolling Astronomer

Volume 47, Number 3, Summer 2005

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

Inside. . .

* Mars. There. What else is there to say? No, our cover photo is not a Hubble image, but instead was taken by ALPO's own Larry Owens with a backyard scope



Also:

• Early news about our ALPO 2006 conference

• Minutes of the ALPO 2005 board of directors meeting

• Book review: Messier Marathons

• Visual intensities of Saturn

• Reports on two Jupiter apparitions

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

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

Volume 47, No. 3, Summer 2005
This issue published in December 2005 for distribution in both portable document format (pdf) and also hardcopy format.

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

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

For membership or general information about the ALPO, contact:

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

E-mail to: will008@attglobal.net

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

In This Issue:

Inside the ALPO

Feature Stories

ALPO Resources

Board Announcement

At its 2005 meeting, the ALPO board of directors voted unanimously to offer the open position of board member to Sanjay Limaye.

Mr. Limaye has accepted this nomination and we hereby offer him our congratulations and welcome him to the board.

Inside the ALPO
Member, section and activity news

Association of Lunar & Planetary Observers (ALPO)

Board of Directors

Executive Director (Chair); Julius L. Benton, Jr.
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Publisher & Editor-in-Chief, Ken Poshedly

Primary Observing Section & Interest Section Staff

(See full listing in *ALPO Resources* at end of issue)
Lunar& Planetary Training Program: Timothy J. Robertson
Solar Section: Acting Coordinator, Rik Hill
Mercury Section: Frank Melillo
Venus Section: Julius L. Benton, Jr.
Mercury/Venus Transit Section: John E. Westfall
Lunar Section:
Selected Areas Program; Julius L. Benton, Jr.
Lunar Transient Phenomena; Anthony Cook
Lunar Meteoritic Impact Search; Brian Cudnik
Acting Coordinator, *Lunar Topographical Studies*; William Dembowski
Coordinator, *Lunar Dome Survey*; Marvin W. Huddleston
Mars Section: Daniel M. Troiani
Minor Planets Section: Frederick Pilcher
Jupiter Section: Richard W. Schmude, Jr.
Saturn Section: Julius L. Benton, Jr.
Remote Planets Section: Richard W. Schmude, Jr.
Comets Section: Acting Coordinator; Ted Stryk
Meteors Section: Robert D. Lunsford
Meteorites Section: Dolores Hill
Computing Section: Kim Hay
Youth Section: Timothy J. Robertson
Historical Section: Richard Baum
Instruments Section: R.B. Minton
Eclipse Section: Michael D. Reynolds
Webmaster: Rik Hill

Point of View
Thank You for Your Support!

By Richard Schmude, Jr; former Executive Director of the ALPO

It has been a pleasure serving as your Executive Director over the past two years. I am grateful to all of the ALPO staff for keeping up with their sections and for recruiting new members. According to Matt Will's most recent report, ALPO membership is at 584 (as of June 30, 2005). At least 11 of the 13 ALPO observing sections have published at least one ALPO feature article in T*he Strolling Astronomer* since the summer of 2003. This shows that our sections are active - keep up the excellent work!

I have spent much of the last four years trying to complete the work that the previous Jupiter coordinators began. This work is now over 99% complete. The writer is grateful to the previous Jupiter coordinators who carefully preserved thousands of Jupiter observations. During the 2003-04 Jupiter apparition, over 100 observers sent in observations; this section is strong and has a bright future.

Looking to the future, I am hoping that ALPO members will continue to carry out two important tasks: 1) Help the new people get acquainted with how to become better observers, and 2) Recruit new members. There are many ways to recruit new members. One way is to give a talk about some aspect of the solar system and then to distribute ALPO membership applications to anyone who is interested in joining.

I feel that it is also important for section coordinators to give observers regular feedback and encouragement. This will be very important for our growth. I can not tell you how many times observers have told me how important encouragement is. Please strive to acknowledge every contribution.

Finally, I hope that you all have fun as you continue to observe/image the planets and other solar system objects.

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

News of General Interest

Dues Change

Faced with rising postal and production costs for this Journal, the ALPO board of directors voted at its 2005 meeting to adjust the ALPO dues strructure accordingly.

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

Yes, This Is the Summer JALPO

Due to circumstances beyond my control, the summer issue of this Journal (Vol 47, No. 3) is extremely late. Outside job, family and other pressures were too much to bear once more and, unfortunately, this volunteer assignment suffered.

As such, there is no Mars preapparition report in this issue; instead, I have featured Mars on the cover of this issue of *The Strolling Astronomer* and will publish the final Mars apparition report as soon as it is compiled and written by the ALPO Mars observing section personnel.

Besides my apologies to you the membership, I also offer a special apology to Jeffrey D. Beish, whose Mars preapparition reports of the past have established a benchmark for observers everywhere to use when preparing to observe and record data on the Red Planet.

I already have begun preliminary work on the autumn issue of this Journal (Vol. 47, No. 4) and hope to complete it shortly.

This Month's Cover

Planet Mars by Larry Owens, Alpharetta (Atlanta) Georgia, USA, taken October 31, 2005, 04:18 UT. This color image is the result of separate monochrome images taken with IR (700-800 nm), red (612-670 nm), green (488-574), & blue (392-508 nm) filters. CM 275.26, diameter 20.15 arc seconds, phase 99.6%, south is at top, stability (seeing) approx. 4 to 6 (scale: 0 poor – 10 best). Instrumentation: Celestron C-14 Schmidt-Cassegrain telescope equipped with Sony ICX98BL-based monochrome ccd camera. No other details provided. For more info, e-mail to planetographer@comcast.net

Reminder: Address changes

Unlike regular mail, electronic mail is not forwarded when you change e-mail addresses unless you make special arrangements.

More and more, e-mail notifications to members are bounced back because we are not notified of address changes. Efforts to locate errant members via online search tools have not been successful.

So once again, if you move or change Internet Service Providers and are assigned a new e-mail address, please notify Matt Will at will008@attglobal.net as soon as possible.

Vacancy on Solar Eclipse Tour

ALPO member Tom Buchanan has sent notification that a spot has opened on the upcoming Sky & Telescope / TravelQuest trip to see the the total solar eclipse from Egypt in March 2006.

Trip itinerary and other details can be found at http://www.tq-international.com/Egypt06/Egypthome.htm or phone 1-800-830-1998; or send e-mail to travel@tq-international.com

ALPO 2006 Conference Set for Atlanta

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

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

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

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

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

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

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

ALPO 2006
Atlanta, Georgia

Founded in 1947

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

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

ALPO Membership Online

The ALPO now accepts membership payment by credit card via a special arrangement with the Astronomical League. However, in order to renew by this method you MUST have Internet access. See the inside back cover of this Journal for details.

Interest Section Reports

Computing Section

By Kim Hay, coordinator

The ALPO Computing Section (ALPOCS) is dedicated to providing comprehensive computational support to the Association of Lunar & Planetary Observers.

The ALPOCS e-mail list, which is located at http://groups.yahoo.com/group/alpocs/ is available to all ALPO members. Currently, we have 217 members on the e-mail list. In the last few months, and we have opened the e-mail list to non-ALPO members to bring in new ideas and exchange interesting topics. We hope that these new individuals will realize that the ALPO team is a great organization and will become members.

To subscribe to the ALPOCS listserv, send a message to: alpocs-subscribe@yahoogroups.com.

Our files are located on the group page as well. We have had several updates to many of the files thanks to Jeff Beish, and also some new files from R. B. Minton, coordinator of the ALPO Instruments Section http://www.lpl.arizona.edu/~rhill/alpo/inst.html .

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

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

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

Instruments Section

By R.B. Minton, coordinator

Visit the ALPO Instruments Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/inst.html and http://mypeoplepc.com/members/patminton/astrometric_observatory/

Lunar & Planetary Training Program

By Tim Robertson, coordinator

Inspired by R.B. Minton's article on astro-imaging with inexpensive webcams in JALPO 47-1 (Winter 2005), your intrepid editor produced this lunar image with a Meade LPI (lunar & planetary imager). The price was under $150, and that includes the imaging software. The labels and arrows were added using Adobe *PhotoShop.*

For information on the ALPO Lunar & Planetary Training Program on the World Wide Web, go to http://www.cometman.net/alpo/; regular mail to Tim Robertson at 2010 Hillgate Way #L, Simi Valley CA, 93065; e-mail to cometman@cometman.net

Observing Section Reports

Eclipse Section

By Mike Reynolds, coordinator

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

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

Meteors Section

By Robert Lunsford, coordinator

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

Comets Section

By Ted Stryk, coordinator

The ALPO Comets Section recent observations page has been updated. Images from ALPO contributors can be seen by going to http://pages.preferred.com/~tedstryk/

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

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

Solar Section
By Rik Hill, acting coordinator

Recently submitted observations may be viewed on the Web at http://www.lpl.arizona.edu/~rhill/alpo/solstuff/recobs.html

Join the ALPO Solar Section e-mail list by visiting the Solar group at http://groups.yahoo.com/group/Solar-ALPO/

Submit all observations to rick2d2@sbcglobal.net

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

Mercury Section
By Frank J. Melillo, coordinator

This section continues to receive many fine drawings and images. The morning apparition of Mercury in December will be of utmost interest. At that time, the region at 280° longitude will be on the terminator and facing towards us. It is at that location that many observers have indicated within the past few years a large circular dark area. Note that this is the portion of Mercury unmapped by the Mariner 10 spacecraft.

A paper about this feature has already been prepared for publication in our ALPO Journal.

While we continue to observe this region as best as we can from Earth, we will know for sure the true nature of this unknown feature only when NASA's MESSENGER (MEcury Surface, Space Environment, GEochemistry and Ranging) spacecraft completes three flybys of the planet and final arrival to orbit the planet in March 2011.

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

Venus Section
By Julius Benton, coordinator

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

Complete details can be found about all of our observing programs in the ALPO Venus Handbook. Individuals interested in participating in the programs of the ALPO Venus Section are cordially invited to visit the ALPO Venus Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/venus.html

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

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

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

During the first half of 2005, a total of 28 different observers submitted 237 drawings and electronic images to the Lunar Topographical Section. Advances in imaging and processing techniques have greatly improved the resolution of lunar images, and several observers have been submitting remarkably detailed photos taken with telescopes less than 15 cm (6 inches) in diameter. Promising work is also being done with special color imaging by Zac Pujic of Brisbane, Australia, whose color saturated images compare favorably with Clementine data on the compositional differences of the lunar surface.

Work is in progress on a summary of Lunations #1002 through #1014 which roughly corresponds to the calendar year of 2004. The completed report will be submitted for publication in this journal shortly. Examples of the latest in lunar topographical studies can always be found in the Lunar Section's newsletter, *The Lunar Observer.* Beause of the continued increase in observations and lunar related articles, TLO has expanded to 20 pages per month and can be accessed at http://www.zone-vx.com/tlo.pdf with at least a year's worth of back issues archived at http://www.zone-vx.com/tlo_back.html

Discussions of the Moon are always welcomed at the Lunar Section e-mail discussion group at http://groups.yahoo.com/group/Moon-ALPO/

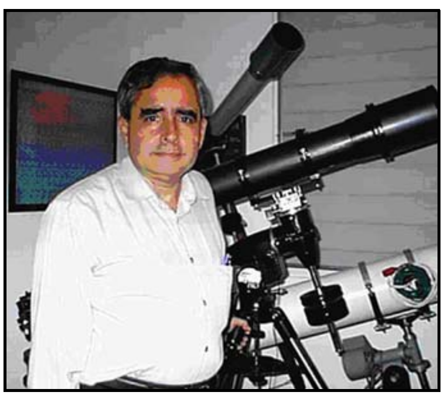
Inside the ALPO
Member, section and activity news (continued)

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

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

Lunar Dome Survey
Marvin Huddleston, FRAS
coordinator

Featured Observer — The backbone of the Lunar Dome Survey has always been the quality people who have contributed to the program over the years. This column is intended to highlight such participants. If you would like to be included and featured in this section, contact the section coordinator, Marvin W. Huddleston, and send him an e-mail containing a bio and photo of you and your equipment. This also gives the reader the opportunity to answer the question, "Gee, I wonder what this guy (or gal) looks like!"



This issue, we feature Guido Santacana, a 53-year-old Cuban-born American living in Puerto Rico, and who earns a living as a professor of human physiology for medical, dental and graduate students, with a total of 30 years in academics.

Guido became interested in astronomy in 1965 when his parents gave him a 2.4-inch refractor along with the book *The Telescope and The World of Astronomy*. Guido became a member of the American Assn. of Variable Star Observers (AAVSO) in 1969 (having joined in 1967); he later joined the ALPO in 1994 and worked with ALPO's own Harry Jamieson on the Lunar Dome Survey in 1997.

Besides the ALPO and the AAVSO, Guido is also a member of the American Lunar Society, as well as his local astronomical society, the Sociedad de Astronomia de Puerto Rico.

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

Announcing the Lunar Dome Certificate Program Observing Team

The ALPO Lunar Dome Survey is pleased to announce the creation of an observing team for the purpose of creating a list of target objects suitable for the novice lunar dome observer, as well as an advanced observers list.

The team members will then observe these objects using a variety of instruments and write detailed descriptions as well as create other forms to record observations (i.e., drawings, images, etc.) of the objects for a forthcoming Lunar Dome Observers Manual and certificate program.

Thus far, the team includes Ed Crandall, Stephen Linscott, Guido Santancana, and Marco Sellini and myself (Marvin W. Huddleston).

Anyone else who would like to participate should e-mail me at kc5lei@comcast.net or kc5lei@hotmail.com

Announcing the Joint Catalog Project

By Marvin W. Huddleston, coordinator, ALPO Lunar Dome Survey; Harry D. Jamieson, founder, ALPO Lunar Dome Survey; Raffaello Braga, Union of Italian Amateur Astronomers; Fernando Ferri, British Astronomical Association; Eric Douglass, American Lunar Society.

The ALPO Lunar Dome Survey is pleased to announce the creation of a powerful new tool in the study of Lunar Domes. The project will be called the Joint Catalog, an effort to create a powerful new catalog and database of observations.

Harry Jamieson, founder of the ALPO Lunar Dome Survey, initiated the idea on the ALPO Lunar Dome Survey e-mail listserv with a suggestion for creation of the joint project. The idea was for all of the organizations currently involved in lunar dome studies to

Association of Lunar & Planetary Observers — ALPO — Founded in 1947

ALPO LUNAR DOME SURVEY

Observation Form

Submit electronically (attach photographs and scanned drawings to e-mail)
to:
***Marvin W. Huddleston*, F.R.A.S.**
kc5lei@comcast.net
or via mail:
2621 Spiceberry Lane
Mesquite, TX 75149-2954

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

Domes Observed (Positions)

Xi	Eta	OR	Lunar Long.	Lunar Lat.

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

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

pool their data, creating both a catalog and database of observational data.

The completed project is envisioned to include a feature where any observation can be viewed from the database, thus making the work of numerous observers over the past 40 years readily available to researchers for the first time. The original ALPO Lunar Dome Survey files alone exceed 3,000 thousand observations!

Following this suggestion, the ALPO LDS extended an invitation to the American Lunar Society, the British Astronomical Association, the Geologic Lunar Researches Group, and the Union of Italian Astronomers International to join us in this project. All of the groups with the exception of the GLR agreed to participate in the effort.

The ALPO looks forward to the cooperative work between the participating organizations and invites all interested parties to join the general discussion group on lunar domes http://groups.yahoo.com/group/lunar-dome/

Lunar Selected Areas
Julius Benton, coordinator

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

Lunar Transient Phenomena
By David O. Darling, assistant coordinator

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

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

Favorable weather for most observers recently has resulted in an abundance of images with a wealth of detail. Early on, there was minimal dust activity and discreet clouds were subdued as well. Some albedo features became more pronounced than usual. A dust storm in October caused a flurry of activity as observers submitted a number of images of the event.

An article which appeared in the September 2005 issue of *Sky & Telescope* magazine was co-authored by one of their editors and by our own Dan Troiani, this Section's coordinator. The observational/computer generated map is included, as were expectations for observers.

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

Minor Planets Section
By Frederick Pilcher, coordinator

In the *Minor Planet Bulletin*, Vol. 32, No. 3, 2005 July-September, are published lightcurves and rotation periods of minor planets by 17 different contributing observers. Many of these have no previous published photometry, and others are significant additional light-

Planet Jupiter by Richard Jakiel, Douglasville (Atlanta), Georgia, USA. This color image is the result of 750 stacked images taken June 10, 2005, 02:00 UT, using Celestron C-11 Schmidt-Cassegrain telescope at f/20; equipped with Celestron NextImage webcam. CM I = 215°, CM II = 154°, CM III = 204°; north at top (source: http://www.arksky.org/JupCMCalc.html); stability (seeing) approx. 6 (scale: 1[worst] - 10 [best]). No other details provided. For more info, e-mail to rjakiel@earthlink.net

Inside the ALPO
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curves at other aspects which contribute toward determination of precise sidereal period, pole orientation, and shape model.. Minor planets included are 106, 120, 400, 423, 463, 471, 523, 544, 553, 642, 675, 752, 790, 829, 847, 883, 1010, 1016, 1057, 1098, 1127, 1158, 1165, 1171, 1182, 1294, 1330, 1450, 1509, 1630, 1670, 1777, 1815, 1919, 1927, 1930, 1936, 1989, 2001, 2065, 2069, 2131, 2251, 2283, 2365, 2426, 2612, 2647, 3037, 3043, 3086, 4087, 4631, 4736, 5035, 5635, 5692, 6235, 6310, 6382, 6475, 6650, 17556, 21181, 23200, 30311, 33896, 70030.

We remind all users and inquirers that the *Minor Planet Bulletin* is a refereed publication. It is now available on line at http://www.minorplanetobserver.com/mpb/default.htm

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

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

During 2004-05, several hundred high quality images of Jupiter have been submitted to the ALPO Jupiter Section. Several white ovals in the North Equatorial Belt were imaged in 2005, plus many people also imaged dark spots (called "barges") in the North Equatorial Belt as well. At least two NEB barges merged earlier this year

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

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Galilean Satellite Eclipse Timing Program
By John Westfall, assistant Jupiter Section coordinator

By the time you read this, planet Jupiter will be observable in the morning sky. Thus, those who have not yet done so are urged to send in their Galilean satellite eclipse timings for the recent 2004-2005 Jupiter Apparition.

Our project consists of making and analyzing visual timings of the eclipses by Jupiter of its four major satellites. The program began in 1977 under Joseph Ashbrook of *Sky & Telescope* magazine; on Dr. Ashbrook's death in 1980, his project became part of the activities of the ALPO Jupiter Section. By now, we have received and analyzed about 8,000 timings from observers on six continents. An apparitional report to be published in the next issue of the *Strolling Astronomer* will tell you more about our ongoing program.

In short, all that an observer needs to participate in our work is a telescope of aperture two inches or greater, a time source accurate to one second (such as a shortwave receiver that can receive WWV or a similar time signal, or a GPS receiver), and a set of eclipse predictions that are available in such publications as the *Astronomical Almanac*, *Sky & Telescope* magazine, or the annual *Handbook* of the British Astronomical Association or of the Royal Astronomical Society of Canada. Predictions are also available on line at http://www.imcce.fr as well as several other sites.

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

Saturn Section
By Julius Benton, coordinator

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn page on the official ALPO Website at http://www.lpl.arizona.edu/~rhill/alpo/sat.html

All are invited to also subscribe to the Saturn e-mail discussion group at Saturn-ALPO@yahoogroups.com

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

Several people including C. Bell, Brian Cudnik, Lynn Laux, Christophe Pellier, and the writer have all submitted observations of the Remote Planets in 2005. Uranus was a little dimmer in May 2005 compared to 2004. Lynn Laux, Christophe Pellier and C. Bell have all imaged Uranus. There were no definite details in any of the images; however a dark smudge is suspected in Lynn Laux's July 30, 2005 image.

The really big news in this section though is the recent discovery of two large objects that lie beyond Neptune; these two objects are called: 2003UB313 and 2003EL61. The second object, 2003EL61, has a satellite, and astronomers have already determined that the combined mass of 2003EL61 and its satellite is about one-fourth the mass of Pluto. The other object, 2003UB313, is too far away for scientists to measure its diameter, but by measuring its light and knowing its distance, scientists can at least estimate it diameter. At this time, 2003UB313 is believed to have a diameter about 50% larger than Pluto's diameter.

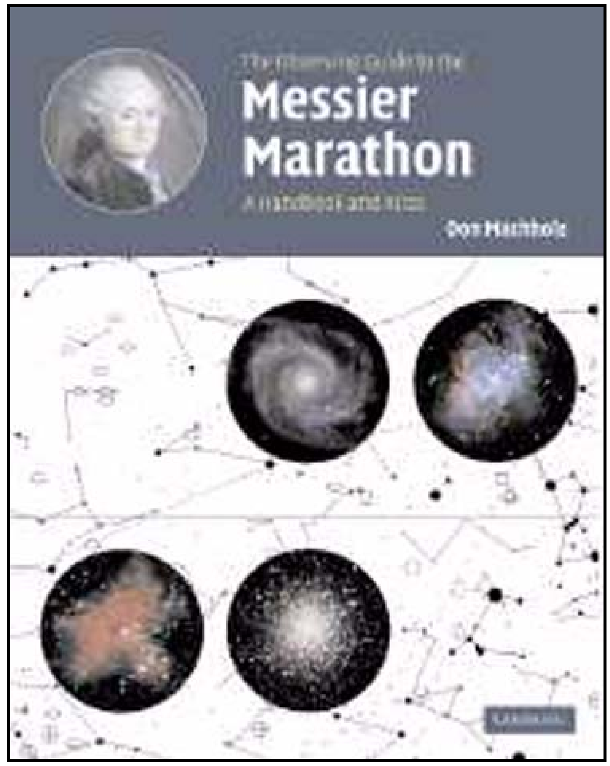
Visit the ALPO Remote Planets Section on the World Wide Web at http://www.lpl.arizona.edu/~rhill/alpo/remplan.html

Book Review:

The Observing Guide to the Messier Marathon

By Don Macholz; published by Cambridge University Press, 40 West 20th Street, New York, 10011-4211. 2002. 172 pages. Price: $25, hardbound, ISBN 0521803861

Review by Richard W. Schmude, Jr.
E-mail to schmude@gdn.edu



This book is organized into two parts, "Handbook" and "Atlas". The "Handbook" portion contains four chapters, which are titled "Charles Messier", "The Messier Catalog", "The Messier Marathon" and "Other Marathons". This part also contains 15 figures, 8 tables, 39 sky maps, a 24-item glossary and a bibliography/further reading section.

"Atlas", the second part of the book, starts off with a small section that describes how to determine the size of your telescope's field of view and then goes on to give finder charts for all 110 Messier objects. The finder charts are organized for the traditional late-March Messier Marathon; the charts begin with M77 and end with M30.

One excellent point of this book is that author Don Macholz clarifies some of the uncertainties of the Messier catalog, such as M102 and M24 (the reader learns that M24 is a huge group of stars in Sagittarius).

The "Handbook" also describes how to plan a Messier Marathon for any particular latitude. As it turns out, people at 45°N can see up to 109 Messier objects in late March whereas a person at 25°N can see all 110 Messier objects between March 15 and 30 — provided that there are clear and dark horizons. The reader also discovers that almost all of the Messier objects can also be seen in late October. The writer also shares his personal experiences with moonlight and observing.

Perhaps the strongest part of the book is the "Atlas". Here, Don gives two types of finder charts for each Messier object. In the case of M65, a large finder chart showing the entire constellation Leo and the general location of M65 is given on page 120 (left page) and on page 121, one finds a detailed finder chart for this object. There is no need to turn the page because everything is on pages 120 and 121. A dashed quarter-circle with a radius of 3° is superimposed on the detailed finder chart. In this way, one can use the chart to determine how much of the sky is visible in his/her instrument.

This book is well-written and I feel that the beginner would find it very useful. It has given me a new inspiration to try a Messier Marathon!

Next Time: A review by Robert Garfinkle of "The Clementine Atlas of the Moon"

(From the Cambridge University Press website) "This atlas is based on the data collected by the Clementine lunar mission of 1994. It covers the entire Moon in 144 Lunar Astronautical Charts (LACs), and represents the most complete lunar nomenclature database in existence, listing virtually all named craters and other features. . . The Clementine Atlas of the Moon will appeal to both professional planetary and space scientists, and serious amateur astronomers."

Feature Story:
Minutes of the ALPO Board Meeting, August 12, 2005

By Matthew Will,
will008@attglobal.net

The ALPO Board Meeting was called to order at 7:07 p.m. CDT by Executive Director Richard Schmude.

Present were board members Julius Benton, Don Parker, Mike Reynolds, Richard Schmude, John Westfall and Matthew Will. Board member Ken Poshedly was not able to attend; however, he was reached by cell phone during the meeting. The first time was to inform him that no speakerphone was made available to us for the meeting and the second time was to ask questions of him about the proposed Atlanta meeting next year. Board member and ALPO Founder Walter Haas could not attend due to health reasons.

Online Readers

•To send a message directly to the author of this article, left-click your mouse on the author's e-mail address in *blue text* to open your own e-mail program (Internet connection must be ON).

•Likewise, left-click your mouse on any website address ("URL", also in *blue text*) to jump to that particular website.

Old Business

Issue One: Approval of the Board Meeting Minutes of 2004

Board meeting minutes for our 2004 ALPO board meeting were approved by all the present board members.

Figure 1. ALPO Executive Director Richard Schmude during presentation of his talk "The 2005 Mars Apparition." (Photo by Julius Benton)

Issue Two: Order of Executive Directors (Introduced by Schmude)

The office of Executive Director has been rotated in alphabetical order among ALPO board members since 1995. Each board member takes a turn as Executive Director for a two-year term. Board members can opt out of this rotation. Currently, Richard Schmude is Executive Director. His term expires after the ALCON 2005 Convention, on August 14, 2005. John Westfall would be the next in line but has no desire to assume the Executive Directorship. Matthew Will would then be the next in line after Richard to become Executive Director. Due to his commitments toward managing the Corporate Secretary, Membership Secretary, and Treasurer's offices, Matt has asked that he be withdrawn for consideration of the Executive Directorship for the time being. Julius Benton will stand in as Executive Director for the next term, expiring in the summer of 2007. Walter Haas, Don Parker and Ken Poshedly expressed no interest in holding this post in the next term running from 2007 to 2009. Mike Reynolds has agreed to serve as Executive Director for the 2007 to 2009 term. Matthew Will continues on as Associate Executive Director in addition to his other duties.

Julius Benton made the following motion: The ALPO Board should keep the current selection of alphabetical rotating the Executive Director amongst the board members who want to participate as Executive Director.

Don Parker seconded the above motion. The Board vote on the motion was 6 yes, 0 no.

Issue Three: Clay Sherrod's Web Site (archiving) (Introduced by Schmude for Clay Sherrod).

The ALPO currently maintains its own web site for displaying observations produced by ALPO observers. These observations, for each observing section, appear during a particular apparition, close approach, or Solar System event and are removed afterwards to save on server space. Archiving these observations is the responsibility of the coordinators of a program.

Clay Sherrod has developed a website (*http://www.arksky.org*) where images and observations by ALPO observers of Jupiter and possibly other planets could be archived. Clay has developed software to retrieve images and observing data for this website. This software can also be used for research purposes by both coordinators and observers.

The rate at which electronic images are being produced by amateurs is growing exponentially in all the major observing sections, and drawings are still being produced by observers at a healthy rate. For example, the Mars Section may well have a million images in its own archives by the year 2020.

Figure 2. Scope and equipment display at this year's Astronomical League convention, ALCON 2005, in Kansas City. (Photo by Julius Benton)

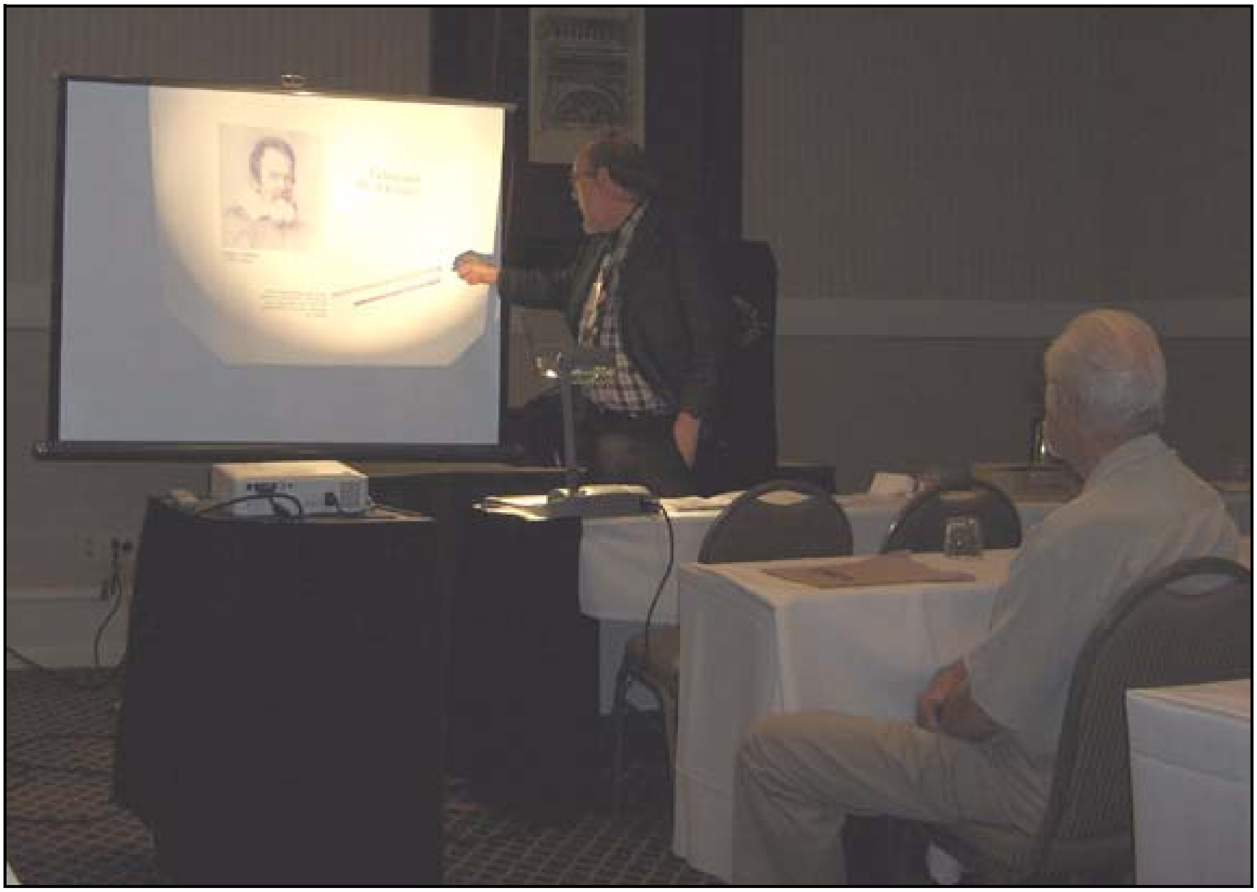


Figure 3. John Westfall during presentation of his talk “Galilean Satellite Eclipses Over the Centuries”. (Photo by Julus Benton)

After some discussion, the Board concluded that Clay Sherrod should write a proposal to the Board to explain how this archiving process would work and what assistance he needs from the ALPO. In the event that the ALPO would want to participate in working and contributing to this archiving system, the Board will craft a signed memorandum of understanding between the ALPO Board and Clay Sherrod, about what it is the ALPO wants with Clay’s system and intellectual property issues that might exist concerning Clay’s software and the use of ALPO images and observational data on Clay’s website.

Issue Four: Board Member Vacancy (Introduced by Schmude)

The ALPO Board discussed the issue concerning the Board seat vacated by Elizabeth Westfall. Elizabeth was also our long-time corporate secretary until she resigned last year from this office and the Board. Matthew Will has been the ALPO corporate secretary for the past year and has agreed to continue on in this post.

The Board discussed some of the abilities that would be needed by a prospective board member in order to carry out future administrative duties for the ALPO. John Westfall mentioned that it would be great if a professional astronomer with strong ties to the amateur community would be on the Board to help promote the ALPO programs and observational databases among professional astronomers.

John thought Sanjay Limaye, assistant coordinator and scientific advisor for the Jupiter Section, could accommodate both areas of need, having both the expertise in administration and a presence in professional astronomy, which could give the ALPO a higher profile with lunar and planetary professionals.

John Westfall made the following motion: The ALPO should send Sanjay Limaye an invitation to join the ALPO Board. If Sanjay declines, we can revisit the issue of the vacant Board seat.

Julius Benton seconded that motion. The Board vote for this motion was 6 Yes, 0 No.

In a related matter, Matthew Will shall send a questionnaire to volunteer staffers and to ALPO members who have worked on past ALPO projects, regarding professional ancillary skills that they may have in the

Figure 4. Julius Benton during presentation of his talk “Observing Saturn: Programs and Recent Observations.” (Photo by John Westfall)

way of supporting future ALPO projects. This includes development of a centralized headquarters still being studied by the ALPO Board at this time.

Issue Five: Selected Areas Program (Introduced by Benton)

Julius Benton reported to the Board that the Selected Areas Program under the Lunar Section has had very little activity in the last few years. Since few if any observations come into this program any more, Julius was open to options on how to best manage this situation. The program could simply be shut down or merged with another. The latter option most appealed to the Board. Richard has agreed to contact the current acting coordinator of the Lunar Topographic Studies Program, William Dembowski, to look into the possibility of merging the Lunar Selected Areas Program into that program.

Issue Six: Policy of Refereeing Papers by Non-staff Members (Introduced by Schmude for Poshedly)

Richard discussed for Board Member Ken Poshedly a problem of peer review of papers that are submitted for publication in the Journal by non-staff personnel not associated with the ALPO. Lack of oversight by a qualified reviewer was the issue here. Richard Schmude suggested that section coordinators should be asked to review any outside papers written about subject matter related to their programs by non-staffers. The Board agreed. No motions or voting were done on this matter; however, this was the consensus that was reached. Matt Will agreed to enter this policy into the Staff Guidelines and the Standing Rules when they are re-released early next year.

Issue Seven: Complaint by a Member: Electronic Subscribers Get Their Journal Before Paper Subscribers (Introduced by Schmude)

Richard mentioned a complaint from an ALPO member about the timing of the release of the paper version of the Journal lagging behind the reception of the electronic or digital version of the Journal. Matt explained that ALPO members receive whichever version they paid for as a part of their membership. The digital version of the Journal is released to the membership as soon as it is ready. The paper version has to be printed and then mailed at a lower postal rate; the entire process, from the time the Journal goes to press to the time it reaches the member’s mailbox, may take up to three weeks.

The ALPO member who complained received the digital version of the Journal. He said that he was not able to respond to an article written in the Journal concerning something written about him by someone else because those writing to him received the digital version of the Journal. This ALPO member did not have the newest Journal available to him to refer to at that time because of the time lag between distribution of both versions.

The Board reached a consensus that, while the timing of the release of the digital version of the Journal can occur up to three weeks ahead of reception of the paper version, both versions are identical in content and eventually become available to all members. There are other differences that distinguish the digital Journal from the paper version, such as color images and active URL links embedded in the articles or papers which lead to other information. Indeed, the differentiation between the two versions was a selling point for establishment of the digital version, and this included receiving the digital version more quickly. The Board felt that members receiving the digital Journal have the right to have access to the current digital Journal as soon as it is ready.

The Board reviewed other policies in regard to distribution and access to the digital Journal and our renewal polices in general. No changes were recommended at this time.

Issue Eight: Finances (Introduced by Matthew Will)

Secretary and Treasurer Matthew Will reported to the Board of the ALPO's finances and reporting activities to governmental agencies in an annual report submitted in February of this year and an interim report concerning this year's activities issued this past July. The ALPO has $4,301.95 in its Springfield account, as of July 31. As of June 30, 2005, the Las Cruces account balance was $2,750.15, while the balance for the Endowment (in a separate account) was $20,720.59.

Currently, the ALPO has experienced cost overruns due to the number of pages of the Journal being printed. Typically, the ALPO can afford to print a Journal issue that runs 50 pages or so; however, larger issues end up costing the organization more than it receives. The current situation is that the Journal is also being subsidized by dues paid by members who voluntarily pay higher dues at Sustaining and Sponsor levels, members who pay for the digital Journal, as well as using our own savings. The U.S. Postal Service will be raising postal rates again in January 2006. To cover all of these issues, the ALPO Secretary / Treasurer recommended to the Board a $2 per-year increase in dues for members receiving the paper Journal and an increase in the higher levels of membership; again, this would offset the organization's reliance on its savings to print and mail the Journal.

Term	Old Rate	New Rate
First Year (four issues, domestic)	$26	$28
Second Year (eight issues, domestic)	$46	$50
First Year (four issues international)	$33	$35
Second Year (eight issues, international)	$60	$64
Sustaining Member (four issues, everyone)	$50	$60
Sponsor (four issues, everyone)	$100	$120

Also, Mike Reynolds has been aggressively pursuing potential advertisers (up to 15 at last count) which — if his efforts come to fruition — could yield the ALPO more income and defer future rate increases. Four of the 15 potential advertisers have answered us with a tentative commitment to placing ads in the Journal. The Board thanked Mike for his efforts to secure badly needed funds through advertisements.

Mike Reynolds made the following motion: The ALPO should increase the membership dues for members receiving the paper version of the Journal by $2 per year. The sustaining membership dues should increase by $10 and the sponsor membership dues should increase by $20 (as indicated in the table above). The rate change will go into effect March 1, 2006.

Don Parker seconded this motion. The Board vote for this motion was 6 votes yes, 0 votes no.

Issue Nine: Remote Planets and Extrasolar Planets Sections (Introduced by Schmude)

With the recent discoveries of relatively large Kuiper Belt objects beyond the orbit of Pluto, Richard wanted to include that class of objects within the Remote Planets Section. Some amateur observations have already been made of the newest "10th planet" and other Kuiper Belt bodies. The Board agreed with Richard's proposal.

Using his powers as Executive Director, Richard also has created a provisional section in the ALPO designed to study the extrasolar planets. Richard will be acting coordinator for this section to get it started, but will pass on the leadership of this section to an interested observer in a couple of years. Richard said that eclipses of stars by planetary bodies in other solar systems have been observed by amateurs in the past, and it is well within the capabilities of many amateurs equipped with instrumentation which can measure light drops of one percent from an eclipsed star. Richard will structure the program with a listing of stars for observation and equipment recommendations. He suggested that the goal of this program should primarily be to monitor stars that already have had planetary bodies discovered orbiting them, since much still needs to be learned about these systems. Discoveries of planets orbiting stars would not be a primary goal of this observing program, but would not be discouraged either.

Issue Ten: All ALPO Journal Volumes in Digital Format (Introduced by Westfall)

John informed the Board about the progress of this issue since last we met. There is a possibility of the first 45 volumes of Journal being put into digital format without any charge to the ALPO by the Astrophysics Data Systems (ADS). This group is managed by the Smithsonian Astrophysical Observatory and funded by NASA. They have already scanned in many professional astronomy journals and have made them available online. The Journal would likewise be online if the ALPO makes available these issues to ADS. John will proceed to talk to ADS about proceeding with the scanning of the Journal into ADS's system. There are only a handful of persons or institutions that have complete collections of the Journal. This makes John's collection a rare thing. His copies of the Journal would be used for scanning. Typically, ADS unstaples the bound copies of a journal to load into their scanner. Afterwards, when scanning is complete, the paper copies are destroyed. Dues to their rarity and the fact that this is a personal collection, destruction of John's copies is, of course, unacceptable. John will ask ADS to return his copies after scanning as a part of our agreement with ADS. John will then restaple the pages. As a test, John will offer issues from Volumes 33 through 42, which he can replace if things go wrong, for scanning to ADS, if ADS agrees to our terms.

Issue Eleven: Indexing the ALPO Journal (Introduced by Schmude)

Richard has proposed developing a cumulative index for the Journal that would include all issues of the Journal up to future Volume 50. (When completed years into the future, the Journal may already have completed 50 volumes). Long-time ALPO member Mike Mattei has already completed a volume-by-volume index, except for volumes 1 through 10. Richard will work on this project, with Walter, Mike, Julius, and John serving on a committee to oversee this, with Richard as committee chair. Richard mentioned that this would be sold to interested persons for a price and could be given to sponsor members as a perk for paying increased dues.

New Business

Issue One: Availability of Membership Listings (Introduced by Schmude)

Richard mentioned that membership listings were being offered in the Journal's ALPO Resources Pages to members at the discretion of the ALPO Secretary. Richard voiced privacy concerns about this offering, since other members may not want to share addresses, phone numbers, etc., with other members. Indeed, the ALPO Secretary has felt uncomfortable about this policy for some time now. However, no requests for membership listings have occurred since Matthew became membership secretary four years ago. After some discussion, the Board felt that offering the membership listings to members not involved directly with ALPO business, i.e., persons other than ALPO officers or section coordinators, may have the potential to compromise a member's privacy. The current offering to have available the membership listings to anyone except ALPO Staff for a cost will be discontinued effective immediately.

Issue Two: Location of the 2006 ALPO Convention (Introduced by Schmude for Poshedly)

Ken Poshedly has extended an invitation for the ALPO to hold our organization's annual paper sessions and business meeting in Atlanta, Georgia. This ALPO-only convention would occur sometime in mid-July, but the exact dates have not yet been selected.

The exact site for the convention would be the Fernbank Science Center. Ken informed Richard that the Fernbank Science Center could be available to the ALPO for little or no cost.

The Board discussed the offer from Ken to host and other possible alternative sites. The Astronomical League is having its ALCON in August of 2006 in Dallas, however, the ALPO has met with the League at either ALCONs or independent conventions five out of the last six years. It would be nice to meet on our own for a change. No other offers to host have been tendered to the Board for 2006. The logistics and especially the economics of the Atlanta site could certainly meet our needs. Since a motel or hotel is not crucial for hosting ALPO activities, the Board decided that attendees of this ALPO convention could find accommodations on their own. Therefore, no funds would be provided for deposits for motel/hotel accommodations. For this convention, the planning committee would consist of Richard, Julius, and Ken. Julius agreed to provide a listing of motels for convention attendees to stay during the convention.

Don Parker made the motion to accept Ken's invitation to meet in Atlanta under the terms in the above paragraph and Richard Schmude seconded. The Board vote was 6 yes and 0 no.

Issue Three: The 2007 Convention (Introduced by Richard)

The Board also considered a tentative invitation from the Royal Astronomical Society of Canada (RASC) to meet in Calgary, Alberta, Canada, in 2007. The ALPO would not only be meeting with the RASC, but with the American Association of Variable Star Observers (AAVSO) as well. Dates were not given, but it would be during the summer of 2007. Richard will confirm that the invitation is still good because it had been eight months since it had been given to us.

Issue Four: Conditions at the 2005 ALCON (General Discussion)

The ALPO has enjoyed a cordial relationship with the Astronomical League over many years. Both organizations have benefited from each others' support in a variety of endeavors, and the ALPO has been appreciative of such support. In light of our past cooperation, it was distressing that the Astronomical League fell short on several arrangements that were made in advance for ALCON 2005.

While the accommodations at the Sheraton Overland Park Hotel were very comfortable, the League's support of the ALPO was lacking. Promises to provide support either did not materialize or were met with impromptu problem-solving. For example:

- The League — while mentioning the ALPO paper sessions and location — did not actually list the schedule of papers being delivered. This list was given to them to be printed in the ALCON program. If convention attendees knew what topics were being covered at what times, they would have been more inclined to visit the paper sessions and sit in on paper sessions they had an interest in.

- A better publicized agenda of papers probably would have mandated a larger room as well. Our paper sessions have been well attended in the past under cramped conditions.

- The League did not have a computer or overhead projectors nor a screen, in place for our PowerPoint presentations. This was requested well ahead of time. John Westfall provided an overhead projector for transparency projections. The computer projector provided by the hotel for PowerPoint presentations was ancient. Its picture kept breaking up and the hotel's projector eventually failed completely later that morning. A working projector from Powell Observatory had to be brought in that afternoon.

- The ALPO asked for display space in the exhibit area several months in advance. Instead, the ALPO found itself excluded by the League from displaying ALPO materials in the exhibit area the night before the convention when exhibitors were setting up. The organizers promised to give us table space outside the entrance of the exhibit area, but it wasn't until the final day of the convention that this happened.

- Finally, no speakerphone was provided to the ALPO for its Board meeting, even though it had been requested weeks in advance.

Perhaps more persistence by the ALPO during the planning stages of this convention would have made the difference in seeing that our needs were met. The Board will look into finding ways to work with the League and other convention providers in the future, perhaps through a standing committee that is in frequent contact with convention providers, to be sure that resources and commitments are honored.

Issue Five: Mars Section Organization (Introduced by Richard)

For clarification to ALPO members, the following will be reflected in the ALPO Resources pages of the Journal as it relates to the Mars Section and receipt of Mars observations.

- CCD observations should be addressed to Don Parker or Richard Schmude.

- Drawing observations should be addressed to Deborah Hines but not to Daniel Troiani. (Note that both have the same post office box address.)

- Dan Troiani corresponds only on work with Martian mapping.

Issue Six: Staff Changes

The following ALPO staff members have been promoted from acting to permanent status:

- Richard Schmude, Assistant Coordinator, Mars Section

- Jamey L. Jenkins, Assistant Coordinator, Solar Section

- William Dembowski, Coordinator, Lunar Section, Topographic Studies

- Ed Grafton, Assistant Coordinator, Jupiter Section

- Marvin W. Huddleston, Coordinator, Lunar Section, Lunar Domes Survey

- Kim Hay, Coordinator, Computing Section

Three staffers have let their memberships lapse and will be contacted to alert them to renew.

With no other business to conduct, the ALPO Board meeting was adjourned at 10:32 p.m. CDT.

Feature Story: A Report on the Jupiter Apparitions of 1993-94 and 1994-95

By Richard W. Schmude, Jr.,
ALPO Jupiter section coordinator
rschmude@gdn.edu

Abstract

Drift rates are reported for several currents in both apparitions. The North Temperate Current C was active in both apparitions. The comet Shoemaker-Levy 9 impact did not have an observable effect on the drift rates of the South Temperate Current or the South South Temperate Current in 1995. The impact spots had visible-light albedos as low as ~0.15 in early August, 1994 and the zones had an albedo of ~0.6 in 1995

Introduction

The highlight of the 1993-94 Apparition (hereafter referred to as the 1994 Apparition since almost all of the observations were made in 1994) was the collision of comet Shoemaker-Levy 9 (SL-9) with Jupiter, whereas the highlight of the 1994-95 Apparition (hereafter referred to as the 1995 Apparition) was the successful insertion of the Galileo spaceprobe into orbit around Jupiter (Hanlon, 2001). The SL-9 impact was reviewed in the professional (Meadows *et al.*, 2001; Carlson *et al.*, 1997; Munoz *et al.*, 1996) and amateur literature (Rogers, 1996a, b; Budine, 1996; Schmude and Bruton, 1995; Hernandez *et al.*, 1997; Westfall, 2000a). Observations made by ALPO members of Jupiter's cloud features are summarized in this report.

Characteristics of the 1994 and 1995 Apparitions are listed in Table 1. Table 2 lists people who sent in observations during 1995; a list of contributors to the 1994 Apparition is shown in (Budine, 1996, 145). Figure 1 shows nomenclature for Jupiter along with drawings. In addition, the Great Red Spot is called the GRS, while the southern border of the NEB is called the NEBs, and so on. Figures 2 and 3 show drawings and images of Jupiter and Figure 4 shows close-up drawings of the GRS. In Figures 1-4, south is at the top and the preceding edge is at the left.

West refers to the direction of increasing longitude. Three longitude systems are used for Jupiter: "System I" (λ_I) applies to the EZ, "System II" (λ_{II}) applies to most of the remaining areas and "System III" (λ_{III}) applies to the planet's underlying "radio" rotation period. Throughout this report, System I longitudes will be used for the EZ, the NEBs and the NTBs areas and System II longitudes will be used for all other areas on Jupiter. Positive wind speeds are those that move from west to east. Planetographic latitudes will be used throughout the report. Feature names are changed for each new apparition; for example, the SSTB oval B2 in 1994 is probably not the same oval as B2 in 1995.

Table 1: Characteristics of the 1994 and 1995 Apparitions of Jupiter*

Apparition period	1993 OCT 18 – 1994 NOV 17	1994 NOV 17 – 1995 DEC 18
Opposition date	**1994 APR 30**	**1995 JUN 01**
At Opposition date: Equatorial diameter (arc-seconds)	44.5	45.5
Magnitude of Jupiter	-2.5	-2.6
Geocentric declination of Jupiter	-13°.4	-21°.2
Jovicentric declination of the Sun	-3°.5	-3°.3
Jovicentric declination of the Earth	-3°.8	-3°.5

*Data from the *Astronomical Almanac* (1993, 1994).

Disc Appearance

Table 3 lists mean light intensities. The light intensity is measured on a scale of 0 = darkest to 10 = brightest. The NEB was the darkest feature in both apparitions with the exception

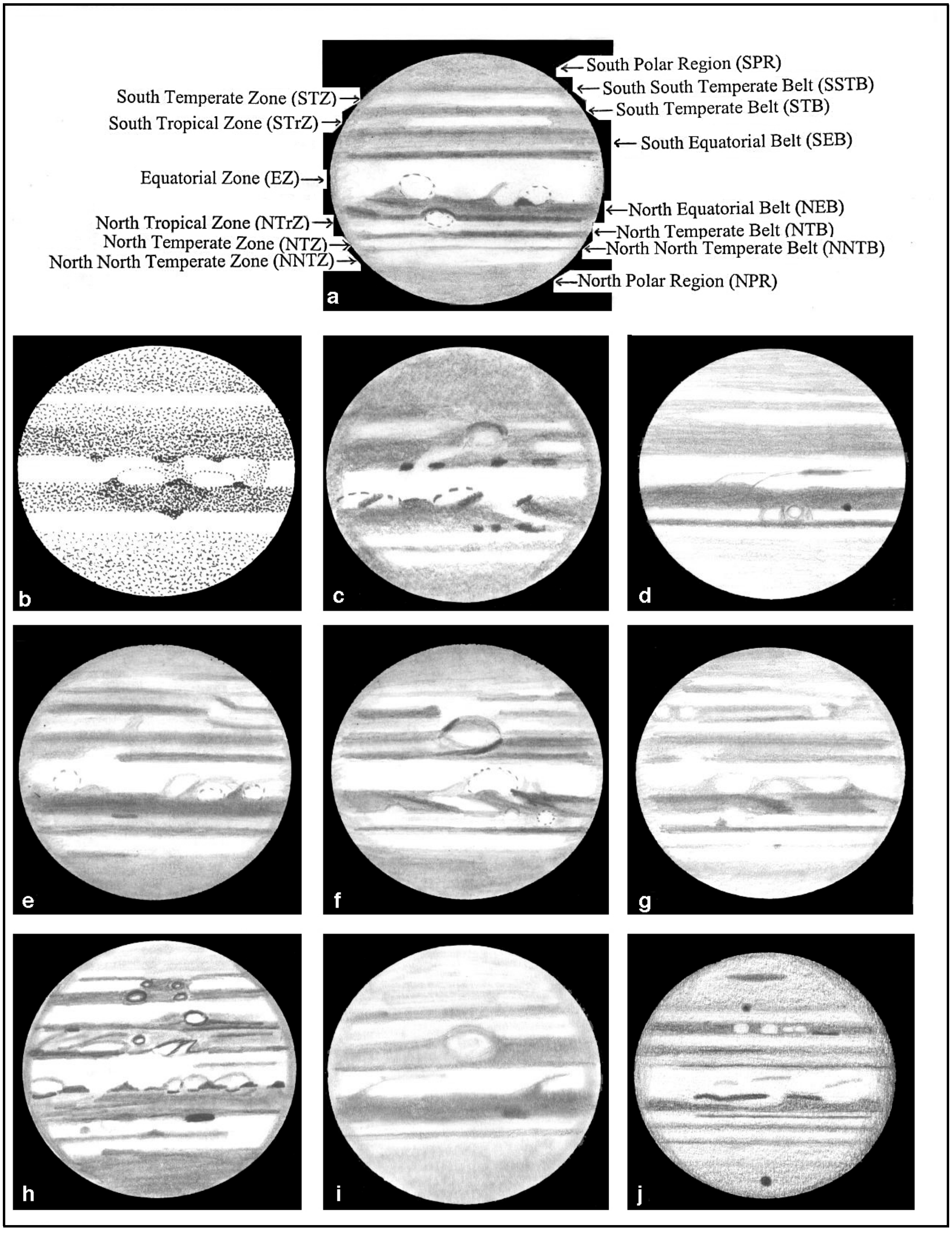


Figure 1: Drawings of Jupiter made in 1994; south at top. (a) Feb. 13 (11:57 UT) by Benninghoven, 0.20-m RL, 236X, λ_I = 304º, λ_{II} = 109º; (b) Jan. 1 (07:25 UT) by Bosselaers, 0.25-m RL, λ_I = 189º, λ_{II} 325º; (c) Feb. 20 (10:39 UT) by Whitby, 0.15-m RL, λ_I = 282º, λ_{II} = 034º; (d) Mar. 5 (07:48 UT) by MacDougal, 0.15-m RL, λ_I = 071º, λ_{II} = 085º; (e) Apr. 22 (04:15 UT) by Benninghoven, 0.30-m RR, λ_I = 326º, λ_{II} = 336º; (f) May 2 (04:15 UT) by Benninghoven, 0.20-m RL, λ_I = 107º, λ_{II} = 040º; (g) May 8 (04:52 UT) by Benninghoven, 0.30-m RR, λ_I = 357º, λ_{II} = 245º; (h) May 11 (03:30 UT) by Budine, 0.15-m RR, λ_I = 062º, λ_{II} = 286º; (i) July 4 (01:17 UT) by Robinson, 0.25-m RL, λ_I = 228º, λ_{II} = 041º; (j) July 17 (02:15 UT) by Schmude, 0.36-m SC, λ_I = 155º, λ_{II} = 229º.

of the SL-9 impact spots in 1994. During 1995, the SL-9 belt was 2.2, 1.0, 0.4 and 0.2 intensity units darker than the SPR during the four time intervals March-April, May-June, July-August, and September, respectively. Miyazaki reported that this belt "faded gradually" in 1995.

The zenographic latitudes of belts, as measured on images, are shown in Table 4. Latitudes were measured in the same way as is described in Schmude (2003b, 36). There appear to be no major latitude changes as a result of the SL-9 impact except for possibly a southern shift in the STB. The biggest change between the 1993 and 1994 Apparitions is the wider SEB in 1994. The biggest change between the 1994 and 1995 Apparitions is the southward shift of the NEBn.

The writer used the same method as in (Schmude, 2002, 26) to measure the dimensions and areas of white ovals on Jupiter. The results are shown in Tables 5A and 5B. Ovals BC, DE and FA had about the same size as in 1992-93 (Schmude, 2003a, 52). The SSTB ovals had a mean aspect and area of 0.86 and 19 x 10^6 km^2 in 1994, which is close to the corresponding values in the previous apparition [aspect is the ratio of north-south extent to east-west extent]. The mean aspect and area for the SSTB ovals in 1995 were 0.94 and 22 x 10^6 km^2.

Tables 6-10 and Figures 5-8 show the drift rates and longitudes of Jovian features and currents.

Region I: Great Red Spot

Figure 4 shows several drawings of the GRS. During March and April 1994, there was a large dark bar in the GRS. This bar was darkest in blue light. Also, the southern rim of the GRS was darker than the northern rim. Color slides made by the writer showed a bright orange bar inside the GRS, which was darker than the surrounding area.

Arnal, Hays, Robinson, Tommey and Whitby reported the GRS to be pale or dusky during 1994. Color slides in 1994 showed an orange color for the southern half of the GRS and a yellow-white color for the northern half of this feature. Color images and slides made in 1995 show a brown-orange color for the southern two-thirds of the GRS and a light orange color for the northern third of the GRS.

The GRS was at λII = 40°.4±0°.5 on April 30, 1994 and λ_{II} = 47°.4±0°.3 on June 1, 1995, which were the two opposition dates. This feature had mean drift rates of +0°.7/30 days (1994) and +0°.5/30 days (1995). The GRS longitudes are plotted in Figures 5 and 7.

Several people made transit timings of the preceding and following edges of the GRS. The mean time difference between the preceding and following edges was 29.6±0.8 minutes based on 25 estimates; this corresponds to an east-west dimension of 20,600±500 km, where the uncertainty includes only random error. This value is much less than the corresponding dimension in Table 5B.

Region II: South Polar Region to the South Tropical Zone

The North and South Polar Regions were close to equally dark in both apparitions. Heath reported that both Polar Regions were darker in a W44A (blue) filter than in a W25 (red) filter for 1994 and 1995. Methane-band images in mid-1995 revealed a bright south polar haze extending to 65°S and a moderately bright north polar haze extending to 63°N.

The writer along with Bruton scrutinized the SSTB region in the weeks before the SL-9 impact and found no large dark spots. Budine (1996) described the development of the impact spots during mid-1994.

The mean System II drift rate of two white SSTB ovals (B1 and B2) in 1994 was –26°.4/30 days, which is close to the mean drift rate between 1986 and 1994 (-26°.6/30 days) (Schmude, 2002, 2003a,b; Lehman, 1999). The 1995 South South Temperate Current (SSTC) drift rate was –23°.2/30 days, which is lower than the corresponding value of -26°.2/30 days reported by Foulkes and Rogers (2000, 246). The drift rate reported by Foulkes and Rogers is based on 10 spots compared to just four for the ALPO study and so an overall drift rate of –25°.3/30 days is selected for the SSTC in 1995; the value selected by Foulkes and Rogers is given a weight of 10 and the value in Table 8 is given a weight of 4. The selected 1995 SSTC drift rate thus chosen lies close to the 1986-94 mean value and so I conclude that the SL-9 comet impact did not affect the 1995 SSTC drift rate. Drift rates for the SSTB ovals are summarized in Tables 6 and 8; longitudes are plotted in Figures 5 and 7.

Oval B2 (1995) passed Oval DE around May 28, 1995. Data were not taken over a long enough period to determine the effects (if any) of B2 passing DE.

Longitudes of the large STB ovals (BC, DE and FA) are plotted in Figure 5 (1994) and Figure 7 (1995). A new STB oval, C4, developed in May and June of 1995 as FA approached the GRS. C4 was not visible in a May 30, 1995 image (Figure 3j) but was visible in an image taken 10 days later (Figure 3k). This oval was also drawn by Benninghoven on June 16 (Figure

Table 2: List of Contributors for the 1995 Apparition Report of Jupiter

Contributor	Location	Telescope*	Type**
Andrews, John	IA USA	0.30-m RR	SS
Benninghoven, Claus	IA USA	0.20-m RL & 0.30-m RR	D, DN, SS, TT
Bosselaers, Mark	Belgium	0.25-m RL & 0.41-m RL	D, DN, TT
Budine, Phillip	NY USA	0.15-m RR	D, DN, TT
Cannaerts, Patricia	Belgium	0.10-m RR & 0.25-m SC	D, DN, TT
Carlino, Lawrence	NY USA	0.28-m SC & 0.15-m RR	D, DN
Cave, Thomas	CA USA	0.33-m RL	D
Cudnik, Brian	AZ USA	0.15-m RR & 0.53-m SC	D, DN
Cuppens, Wim	Belgium	0.20-m SC & 0.20-m RR	D, TT
Del Valle, Daniel	PR USA	n.a.	n.a.
De Paepe, Hubert	Belgium	0.20-m RL	TT
Goertz, Hans	Belgium	0.10-m RR	D, TT
Goossens, Bram	Belgium	0.25-m SC	D, TT
Goossens, Koen	Belgium	0.20-m RR	D, TT
Gravers, Gerda	Belgium	Not given	TT
Haas, Walter	NM USA	0.20-m RL & 0.32-m RL	SS, TT
Hays, Robert, Jr.	IL USA	0.15-m RL	D, DN, SS, TT
Heath, Alan	England	0.30-m RL	D, DN, TT
Hernandez, Carlos	FL USA	0.20-m RL	D, SS, TT
Johnson, Gus	MD USA	Several	D
Lehman, David	CA USA	0.25-m RL	D, SS, TT
Liu, Joseph	CA USA	0.20-m RR	P
Lopata, Eugene	CA USA	0.30-m RL	PP
MacDougal, Craig	FL USA	0.15-m RL	D, DN, TT
Melillo, Frank	NY USA	0.20-m SC	DN
Miyazaki, Isao	Okinawa, Japan	0.41-m RL	CCD, DN, TT
Niechoy, Detlev	Germany	0.20-m RL & 0.30-m RL	D, DN
Olivarez, Jose	KS USA	0.25-m RR & 0.41-m RL	D, DN, R, SS, TT
Parker, Donald	FL USA	0.41-m RL	CCD
Pearsall, James	TN USA	0.20-m RL	CCD
Plante, Phil	OH USA	Several	D, TT
Post, Cecil	NM USA	Several	D, SS, TT
Ramaekers, Nico	Belgium	0.15-m Mak	D, TT
Ramon, Johan	Belgium	Not given	D, TT
Robinson, Robert	WV USA	0.25-m RL	D, DN, TT
Rummler, Jens	LA USA	0.20-m RL	D, DN, SS
Schmidt, Mark	WI USA	0.36-m SC	CCD
Schmude, Richard Jr.	TX & GA USA	0.09-m RR & 0.36-m SC	D, DN, P
Tatum, Randy	VA USA	0.25-m RL	TT
Teichert, Gerard	France	0.28-m SC	D, DN
Tomney, Jim	MD USA	0.15-m RL	D, DN
Vargas, A. Gonzalo	Bolivia	0.20-m RL	D, DN
Verwichte, Erwin	Belgium	0.20-m RR	D, TT
Westfall, John	CA USA	0.28-m RL	CCD, PP
Whitby, Samuel	VA USA	0.15-m RL	D, DN, SS

* Mak = Maksutov, RL = Reflector, RR = Refractor, and SC = Schmidt Cassegrain

** CCD = CCD images or video, D = drawings, DN = descriptive notes, P = photographs, PP = photoelectric photometry, R = preliminary report, SS = strip sketch, and TT = transit timings

Table 3: Mean Intensities of Belts and Zones on Jupiter
All intensities are on the ALPO scale of 0 = darkest to 10 = brightest.

Feature	1994 Intensity (color)	1995 Intensity (color)
SPR	6.6	6.3
Shoemaker-Levy 9 Belt	---	5.7*
SSTZ	7.0	6.5
SSTB	5.9	4.9
STZ	7.5	7.4
STB	5.5 (brown-gray)	5.5
STrZ	8.3	8.5
SEBs	5.3 (orange-brown)	4.5 (brown)
SEBn	4.9 (brown)	5.3 (orange-brown)
EZ	9.0	8.1
EB	6.5	6.1
NEB	4.4 (dark brown to brown)	3.8 (brown)
NTrZ	8.2	8.2
NTB	4.5 (brown)	5.1 (brown)
NTrZ	8.4	7.8
NNTB	5.9 (brown-gray)	---
NPR	6.6	6.4 (gray)
GRS	6.7 (orange)	5.4 (orange)

* Variable

2i), June 18 (Figure 2j) and July 29 (Figure 2l). The July 29 drawing shows C2 and C4 very close to each other; this indicates a merger. The formation of C4 may have affected the drift rate of FA; see Figure 7. There was a change in the drift rate of FA around June 20, 1995. Between May 13 and June 20 1995, FA's drift rate was –15°.1/30 days whereas between June 20 and Aug. 6 1995, the drift rate dropped to –11°.3/30 days.

A distinct oval (C1) in 1994 was located in the STrZ. Figure 5 shows the longitudes of this feature. The drift rate for C1 was –0°.6/30 days. In 1995, a similar feature, C5, was located at λ_{II} = 305° in mid June; its drift rate was +3°.3/30 days.

Region III South Equatorial Belt

The general appearance of the SEB is shown in Figures 1-3. During March and April, 1994 oval S1 was visible on the SEBn. S1 had a drift rate of +26°.8/30 days (System I) and a wind speed of 92.7 m/s; this is consistent with the results in Rogers (1995, 162) and with Peek's "Great Equatorial Current: Southern Branch B" (Peek, 1981, 194).

The mean width of the SEB between 1986 and 1994 was 14°.3. The width of the 1995 SEB was 14°.2 and so the SL-9 impact had little effect on the SEB width.

Region IV Equatorial Zone

There were not enough data to determine the lifetimes of the 1994 festoons. The festoons in 1995 usually lasted for at least six weeks. In all cases, the bases of festoons (located on the NEBs) were used in measuring the equatorial current. The 1994 and 1995 System I drift rates for the equatorial currents were +3°.0/30 days and +0°.8/30 days, respectively; see Tables 7 and 9. The corresponding 1991-92 and 1992-93 drift rates were +0°.9/30 days and +0°.3/30 days respectively (Schmude, 2002; 2003a).

Region V: North Equatorial Belt

Two ovals in the NEB in 1994 had an mean drift rate of –2°.9/30 days (System II), which is consistent with drift rates measured for similar features in 1988-89 (-2°.1/30 days), 1990-91 (+2.0°/30 days), and 2001-02 (-5°.8/30 days). The mean latitude for the NEB white ovals for five apparitions between 1988 and 2003 was 19°.5 N, which is close to the 1994 latitude of 20°.2 N. White ovals were not detected in the NEB in 1995 because that belt extended to just 16° N, which is 3°.5 south of the mean oval latitude. The white ovals may have been present in 1995 but they then would have been in the bright NTrZ.

The longitudes for projections on the NEBn and barges within the NEB are shown in Figures 5 and 7. Mean System II drift rates for projections and/or barges were –3°.6/30 days (1994) and +0°.5/30 days (1995). These values are close to those measured in 1991-93 (Schmude 2002, 2003a).

Region VI: North Tropical Zone to the North Polar Region

Dark bumps were present on the NTBs during 1994 and 1995 and these moved at a rate consistent with the North Temperate Current C. Three features in 1994 had a mean System I drift rate of –53°.5/30 days and five features in 1995 had a mean System I drift rate of –60°.4/30 days; Figures 6 and 8 show the

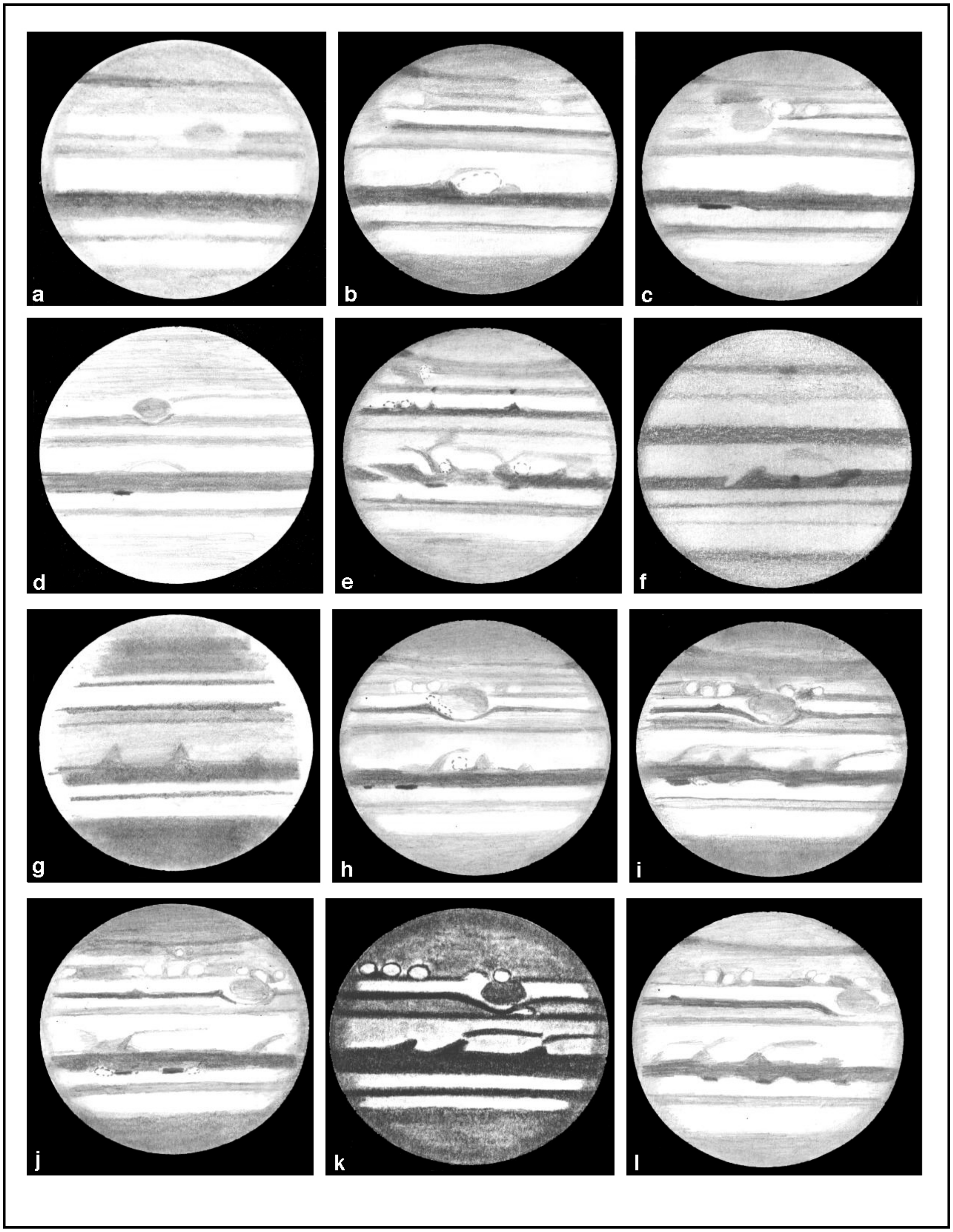


Figure 2: Drawings of Jupiter made in late 1994 (a) and 1995 (b-l); south at top. (a) Dec. 21 (12:20 UT) by Whitby, 0.15-m RL, λ_I = 081º, λ_{II} = 034º; (b) Feb. 5 (12:18 UT) by Benninghoven, 0.20-m RL, λ_I = 137º, λ_{II} = 099º; (c) Feb. 12 (11:58 UT) by Benninghoven, 0.20-m RL, λ_I = 150º, λ_{II} = 058º; (d) Mar. 23 (09:06 UT) by MacDougal, 0.15-m RL, λ_I = 083º, λ_{II} = 055º; (e) Apr. 2 (11:08 UT) by Benninghoven, 0.30-m RR, λ_I = 297º, λ_{II} = 192º; (f) May 14 (04:09 UT) by Schmude, 0.09-m RR, λ_I = 198º, λ_{II} = 135º; (g) May 24 (03:48 UT) by Rummler, 0.20-m RL, λ_I = 326º, λ_{II} = 186º; (h) May 30 (05:02 UT) by Benninghoven, 0.20-m RL, λ_I = 239º, λ_{II} = 053º; (i) June 16 (04:03 UT) by Benninghoven, 0.20-m RL, λ_I = 010º, λ_{II} = 054º; (j) June 18 (04:45 UT) by Benninghoven, 0.20-m RL, λ_I = 351º, λ_{II} = 021º; (k) July 27 (02:25 UT) by Olivarez, 0.25-m RR, λ_I = 305º, λ_{II} = 038º; (l) July 29 (03:30 UT) by Benninghoven, 0.20-m RL, λ_I = 300º, λ_{II} = 017º.

Table 4: Mean Planetographic Latitudes of Belts on Jupiter (All latitudes measured from images made in either integrated light or of blue, green and red images*)

Belt	Planetographic Lat. March-April, 1994	Planetographic Lat. July 19-Aug. 4, 1994	Planetographic Lat. May – July, 1995
NNTBn	39°.8 ±1ºN	38°.5 ±1ºN	38°.1 ±1ºN
NNTBs	35°.1 ±1ºN	34°.3 ±1ºN	34°.4 ±1ºN
NTBn	29°.1 ±1ºN	28°.1 ±0°.5 N	28°.6 ±0°.5 N
NTBs	24°.1 ±1ºN	24°.2 ±1ºN	22°.9 ±1ºN
NEBn	20°.6 ±1ºN	19°.7 ±1ºN	16°.0±1ºN
NEBs	7°.4 ±0°.5 N	6°.3 ±0°.5 N	5°.9 ±0°.5 N
EBc	0°.3 ±0°.5 S	0°.4 ±1ºS	2°.1 ±1ºS
SEBn	7°.2 ±1ºS	7°.2 ±1ºS	7°.7 ±1ºS
SEBs	23°.0 ±1ºS	21°.7 ±1ºS	21°.9 ±1ºS
GRSc	23°.5 ±0°.5 S	Not enough data	23°.0 ±0°.5 S
STBn	28°.2 ±1ºS	29°.4 ±1ºS	30°.0 ±1ºS
STBs	36°.9 ±1ºS	38°.3 ±1ºS	35°.5 ±1ºS
SSTBn	Not visible	Not visible	39°.4 ±1ºS
SSTBs	Not visible	Not visible	44°.1 ±1ºS
SSSTBn	Not visible	Not visible	48°.2 ±1ºS
SSSTBs	Not visible	Not visible	52°.4 ±1ºS

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

longitudes of these features. These rates are consistent with those in the early 1990s (Schmude, 2002, 2003a), (Rogers and Foulkes, 1994, 176).

Two small ovals (G1 and G2) with dark festoons behind them were between the NTBn and the NTZ in 1995. These features had a mean System II drift rate of +11°.6/30 days, which is consistent with the North Temperate Current (Rogers, 1995, 103).

Three dark spots (H1-H3) in 1994 had a mean System II drift rate of –67°.5/30 days, which is consistent with the North North Temperate Current B. Two dark spots in 1995 (H1 and H2) had a mean System II drift rate of +6°.7/30 days, which is consistent with the North North Temperate Current. The 1994 and 1995 spots had a similar appearance but they were at different latitudes; 35°.1 N (1994) and 41°.3 N (1995).

A dark end of the NNNTB (I1) at 45° N had a System II drift rate of +6°.8/30 days. It is unclear if this represents a true drift rate since it is not a projection, spot or oval. The drift rate of I1 does not match up with the value of –15°.2/30 days reported by Rogers (1995, 86) for the North North North Temperate Current.

Satellites

Westfall (1999; 2000b) summarized visual Galilean satellite eclipse timings for the 1994 and 1995 Apparitions.

Post observed both Io and its shadow near Jupiter's central meridian on June 10, 1995 at 05:42 UT; Post drew Io as a ball that was brighter than any of the zones on Jupiter. Cudnik also observed Io near Jupiter's central meridian on October 28, 1995 and drew it as being as bright as the zones. Io had visible-light albedos of 0.68 and 0.59 on June 10 and October 28, respectively (Schmude, 2004), and so I conclude that Jupiter's zones all had visible-light albedos near 0.6 in mid-to-late 1995.

Parker imaged Jupiter, Ganymede and that moon's shadow on May 23, 1995 at 4:36 UT (Figure 3i). I myself measured the diameter of Ganymede and its shadow to be 5,540 km [the *Astronomical Almanac for the Year 2006*, p. F3, gives Ganymede's diameter as 5,268 km. ed.] and 7,170 km respectively. The shadow diameter was 29 percent larger than Ganymede's measured diameter. The theoretical diameter of the umbra portion of Ganymede's shadow was about 1,800 km on May 23, 1995 and so most of the shadow was the penumbra. The shadow does not gradually blend in with Jupiter but instead there is an abrupt end of the shadow. In a June 6, 1994 photograph, Ganymede's shadow does blend in with Jupiter (Figure 3f).

SL-9 Impact: Unique Observations

On July 16-22, 1994, some 23 fragments of comet Shoemaker-Levy 9 impacted Jupiter. Falsarella drew impact spots G, D and E as dark as Ganymede on July 18, 1994. Satellite shadows of Ganymede, Europa and Io were consistently observed to be darker than the impact sites. Based on photographs and images, I estimate a visible-light albedo of 0.15 for the darkest parts of the impact features.

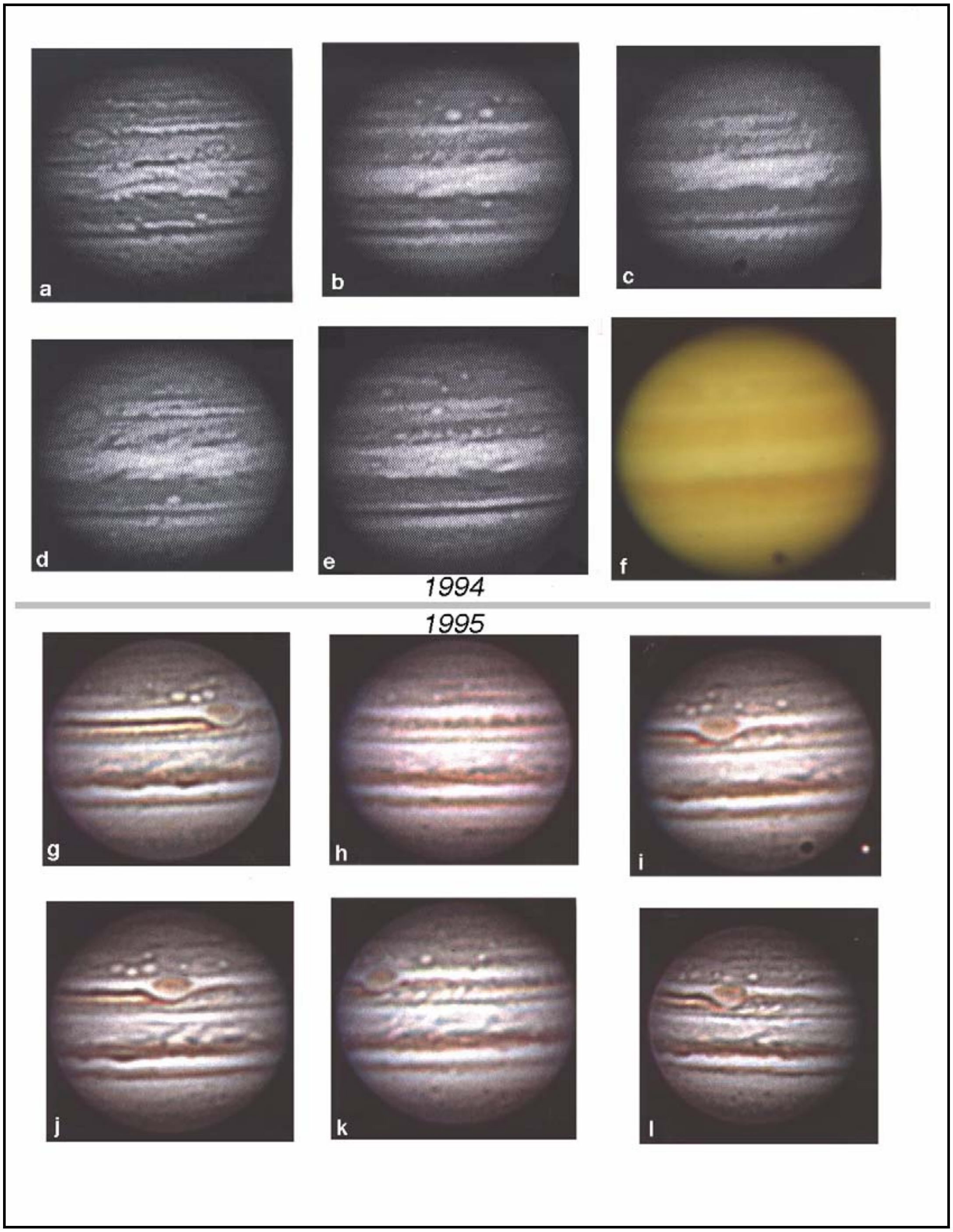


Figure 3: Photographs and images of Jupiter made in 1994 (a-f) and 1995 (g-l); IL = integrated light; south at top. (a) Mar. 10, 1994 (06:33 UT) by Parker, red light, λ_I = 095º, λ_{II} = 072º; (b) Mar. 18, 1994 (06:34 UT) by Parker, green light, λ_I = 280º, λ_{II} = 196º; (c) Mar. 19, 1994 (07:07 UT) by Parker, IL, λ_I = 098º, λ_{II} = 006º, shadow of satellite Ganymede at lower left; (d) Apr. 3, 1994 (06:30 UT) by Parker, IL, λ_I = 286º, λ_{II} = 080º; (e) Apr. 17, 1994 (04:23 UT) by Parker, IL, λ_I = 261º, λ_{II} = 309º; (f) June 6, 1994 (02:12 UT) by Schmude, IL, λ_I = 161º, λ_{II} = 188º, shadow of Ganymede at lower right; (g) May 13, 1995 (04:57 UT) by Parker, IL, λ_I = 070º, λ_{II} = 014º; (h) May 16, 1995 (05:25 UT) by Parker, IL, λ_I = 201º, λ_{II} = 122º; (i) May 23, 1995 (04:36 UT) by Parker, IL, λ_I = 197º, λ_{II} = 065º, satellite Ganymede and its shadow at lower right; (j) May 30, 1995 (04:49 UT) by Parker, IL, λ_I = 231º, λ_{II} = 046º; (k) June 9, 1995 (04:16 UT) by Parker, IL, λ_I = 352º, λ_{II} = 090º; (l) July 3, 1995 (03:20 UT) by Parker, IL, λ_I = 149º, λ_{II} = 064º.

Table 5: (A) Dimensions of White Ovals During the 1994 Apparition of Jupiter

Feature	Dimension (km)		Aspect*	Area (10^6 sq km)
	East-West	North-South		
A1[a]	5400	5800	1.08	25±4
B1	5500	4600	0.84	20±2
B2	5500	4200	0.76	18±4
B3[a]	4900	4800	1.00	19±3
B4[a]	5300	4500	0.85	19±3
Oval BC	9500	7400	0.78	55±4
Oval DE	9600	7200	0.75	54±3
Oval FA	8500	6600	0.80	44±4
C1	7600	5100	0.65	30±3
N1	7900	5000	0.63	31±1
N2	5700	4000	0.72	18±1

[a]There were not enough data to compute drift rates for these features; A1 was at λ_{II} = 172º on Mar. 20, 1994; B3 was at λ_{II} = 043º on Mar. 10, 1994 and B4 was at λ_{II} = 177º on Mar. 18, 1994.

Table 5: (B) Dimensions of White Ovals and GRS During the 1995 Apparition of Jupiter

Feature	Dimension (km)		Aspect*	Area (10^6 sq km)
	East-West	North-South		
A1	6400	6000	0.93	30±3
B2	5300	5000	0.94	21±2
B3	4400	4100	0.94	14±1
B4	6500	6000	0.94	31±3
Oval BC	9600	6600	0.69	50±2
Oval DE	8800	7100	0.81	50±2
Oval FA	7000	5500	0.78	30±2
C1	7000	5800	0.82	32±1
C2	4400	4100	0.92	14±1
C3	4500	4300	0.95	15±1
C4	5700	5200	0.93	23±1
GRS	24,000	12,200	0.51	230±11
G1	5700	4100	0.73	18±2
G2	5900	4700	0.80	22±3

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

Heath reported a dark gray color for the K impact site on July 19, but reported a brown color for this same feature on August 5 and 13. On August 15, Heath noted that the K site had become a dark smudge. Heath also reported that the L and D/G impact sites were darker in red light than in blue light on August 13, 1994.

Whitby reported on September 13, 1994 that the SL-9 belt was best seen in orange light. Six days later, he reported that this belt was the darkest one on Jupiter.

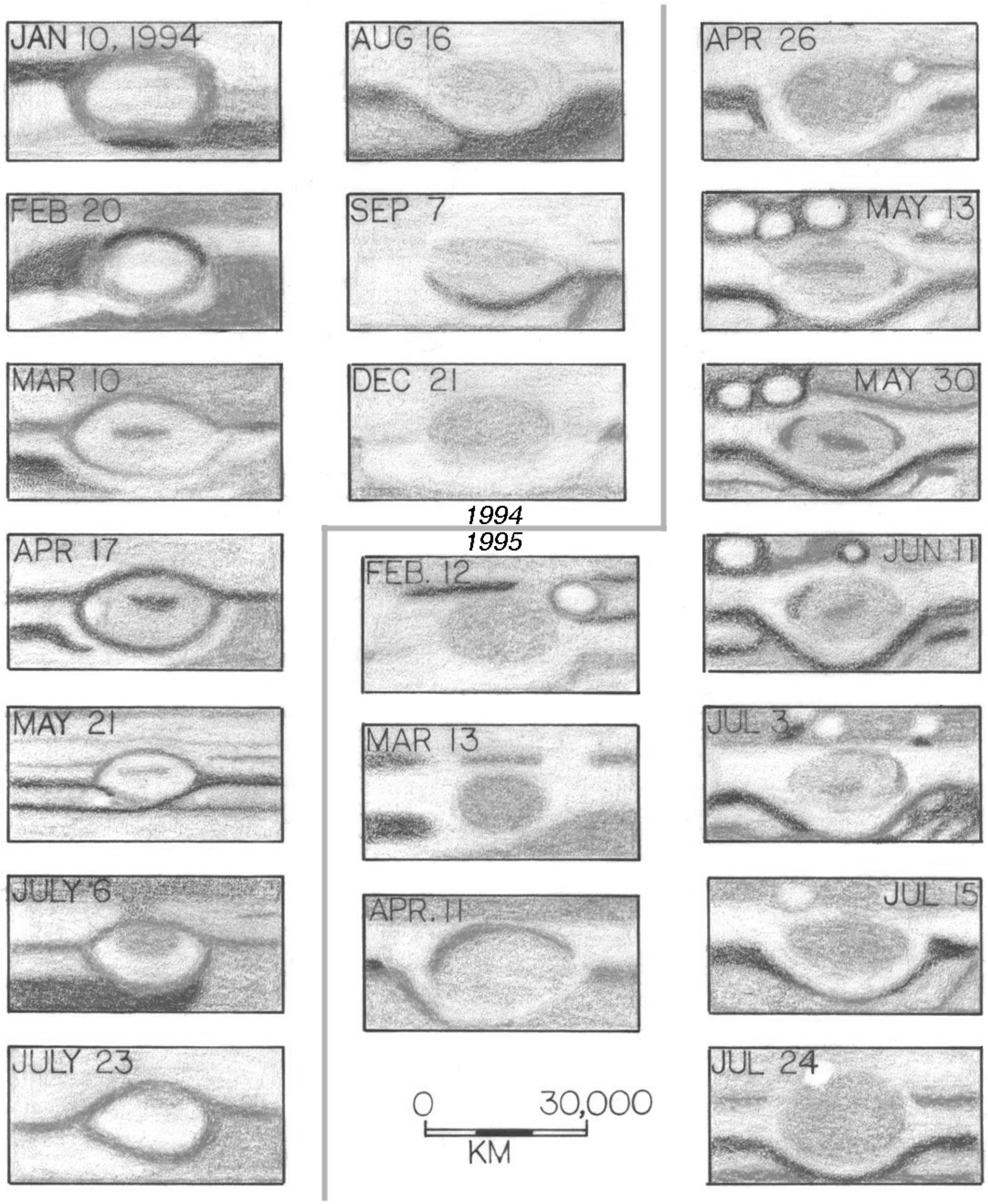


Figure 4: Close-up drawings of the Great Red Spot; dates are shown in each box, with south at top. The year is 1994 for the first column and the top three drawings in the second column; the year is 1995 for the remaining drawings.

Table 6: Drift Rates of Features in System II Longitude in the 1994 Apparition of Jupiter

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
South South Temperate Current					
B1	3	Mar. 20 – Apr. 6	43°.2 S	-27.0	9h 55m 04s
B2	7	Dec. 19 – Mar. 7	41°.8 S	-25.8	9h 55m 05s
	Mean		*42°.5 S*	*-26.4*	*9h 55m 05s*
South Temperate Current					
Oval FA	22	Apr. 2 – Aug. 10	33°.3 S	-14.9	9h 55m 20s
Oval BC	26	Mar. 30 – Aug. 7	32°.4 S	-12.3	9h 55m 24s
Oval DE	35	Mar. 13 – Aug. 7	33°.4 S	-12.0	9h 55m 24s
	Mean		*33°.0 S*	*-13.1*	*9h 55m 23s*
South Tropical Current					
GRS	44	Feb. 6 – July 30	23°.5 S	+0.7	9h 55m 42s
C1	10	Mar. 19 – June 18	23°.3 S	-0.6	9h 55m 40s
North Equatorial Current (barges)					
N3	5	June 4 – June 19	18°.4 N	-5.4	9h 55m 33s
N4	7	Mar. 19 – May 6	16°.1 N	-5.8	9h 55m 33s
N5	7	Feb. 20 – Apr. 25	15°.6 N	+0.3	9h 55m 41s
	Mean		*16°.7 N*	*-3.6*	*9h 55m 36s*
North Equatorial Current (ovals)					
N1	13	Mar. 5 – July 9	20°.5 N	-4.7	9h 55m 34s
N2	7	Mar. 19 – May 28	19°.8 N	-1.2	9h 55m 39s
		Mean	*20°.2 N*	*-2.9*	*9h 55m 37s*
North North Temperate Current B					
H1	5	Mar. 18 – Apr. 6	35°.1 N	-69.1	9h 54m 06s
H2	5	Mar. 18 – Apr. 6	35°.1 N	-72.2	9h 54m 02s
H3	4	Mar. 18 – Apr. 6	35°.1 N	-61.2	9h 54m 17s
		Mean	*35°.1 N*	*-67.5*	*9h 54m 08s*
North North Temperate Current					
H4	3	Mar. 10 – Apr. 3	41°.8 N	+0.7	9h 55m 42s

Miyazaki noted that the SL-9 impact belt was not bright in 893-nm methane-band light.

The SL-9 impact had little or no long-term effect on the drift rates in the South Temperate Current or the South South Temperate Current, because the 1995 drift rates were consistent with historical rates. Similarly the impact had almost no effect on belt latitudes; however it may have led to the SSTB and SSSTB being more distinct in 1995. The darkest impact spots had visual albedos of about 0.15, which is lower than the albedo of about 0.5 for the SSTB and the SSSTB. The impact spots covered up to 4 percent of Jupiter's disc as seen from the Earth in early August and so Jupiter's brightness should have dropped by about (0.5 – 0.15) x 4% = 1.4% or 0.015 magnitudes as a result of the SL-9 impact. This is also consistent with Westfall (2000a, 73) who found no global change in Jupiter's V-magnitude due to the comet impact.

Dan Troiani used a high-quality Radio Shack shortwave receiver along with a 7.1-meter dipole antenna to study Jupiter's radio signal before and during the impact of fragment A. He tuned his receiver to a frequency of 22.205 megahertz. At 19:30 UT on July 16, Troiani noticed an increase in radio emission, and at 20:14 UT, about 2 minutes after light from the impact of fragment A reached the Earth, the radio emissions became louder with more static. Unfortunately, this particular radio observation was not confirmed.

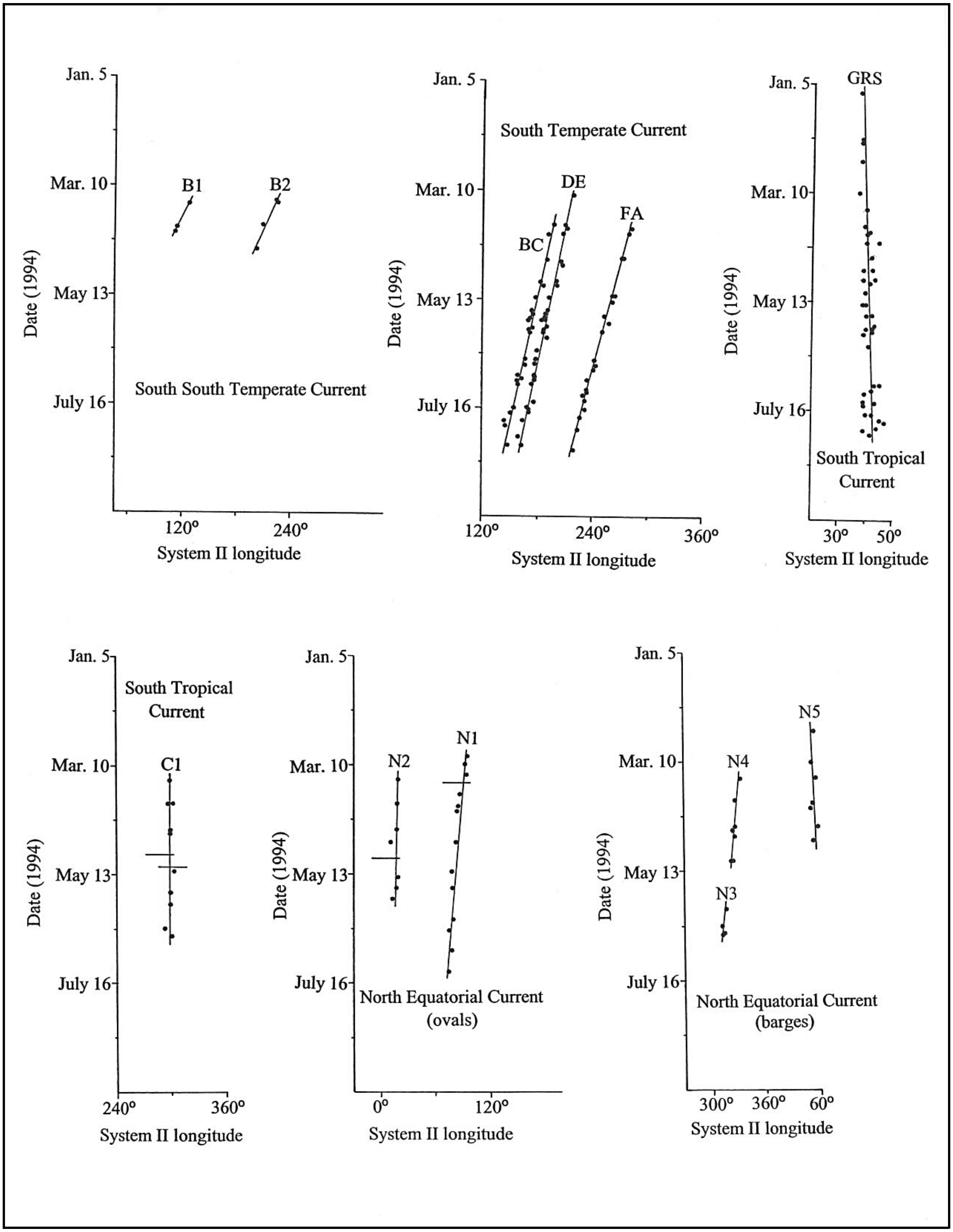


Figure 5: Longitudes for various features on Jupiter in 1994. Dots and open circles are longitude measurements (primarily ccd images) whereas horizontal lines are estimated longitudes from drawings.

Table 7: Drift Rates of Features in the Equatorial Zone, and in the North Temperate Current C, in the 1994 Apparition of Jupiter

Equatorial Current (Festoons)

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System I	Rotation Period
E1	3	Mar. 10 – Mar. 19	7°.4 N	-1.7	9h 50m 28s
E2	3	Mar. 10 – Apr. 2	7°.4 N	-4.9	9h 50m 24s
E3	4	Mar. 18 – Apr. 17	7°.4 N	+7.7	9h 50m 40s
E4	5	Jan. 1 – Feb. 15	7°.4 N	+6.6	9h 50m 39s
E5	4	Jun. 19 – July 16	7°.4 N	+0.1	9h 50m 30s
E6	4	May 10 – June 20	7°.4 N	-1.7	9h 50m 28s
E7	4	May 6 – May 25	7°.4 N	+13.7	9h 50m 48s
E8	6	May 21 – July 2	7°.4 N	+4.5	9h 50m 36s
		Mean	*7°.4 N*	*+3.0*	*9h 50m 34s*
Equatorial Current Southern Branch					
S1	5	Mar. 18 – Apr. 17	7°.2 S	+26.8	9h 51m 06s
North Temperate Current C					
F1	5	Mar. 18 – Apr. 17	24º N	-53.5	9h 49m 18s
F2	4	Mar. 18 – Apr. 17	24º N	-57.1	9h 49m 13s
F3	2	Mar. 10 – Mar. 19	24º N	-50.0	9h 49m 23s
		Mean	*24° N*	*-53.5*	*9h 49m 18s*

Wind Speeds

Wind speeds for different currents are summarized in Tables 10A and 10B. In all cases, wind speeds are given with respect to System III longitudes. The wind speeds and uncertainties are computed in the same way as in Schmude (2002).

Acknowledgements

I would like to thank everyone who sent in Jupiter data during 1994 and 1995.

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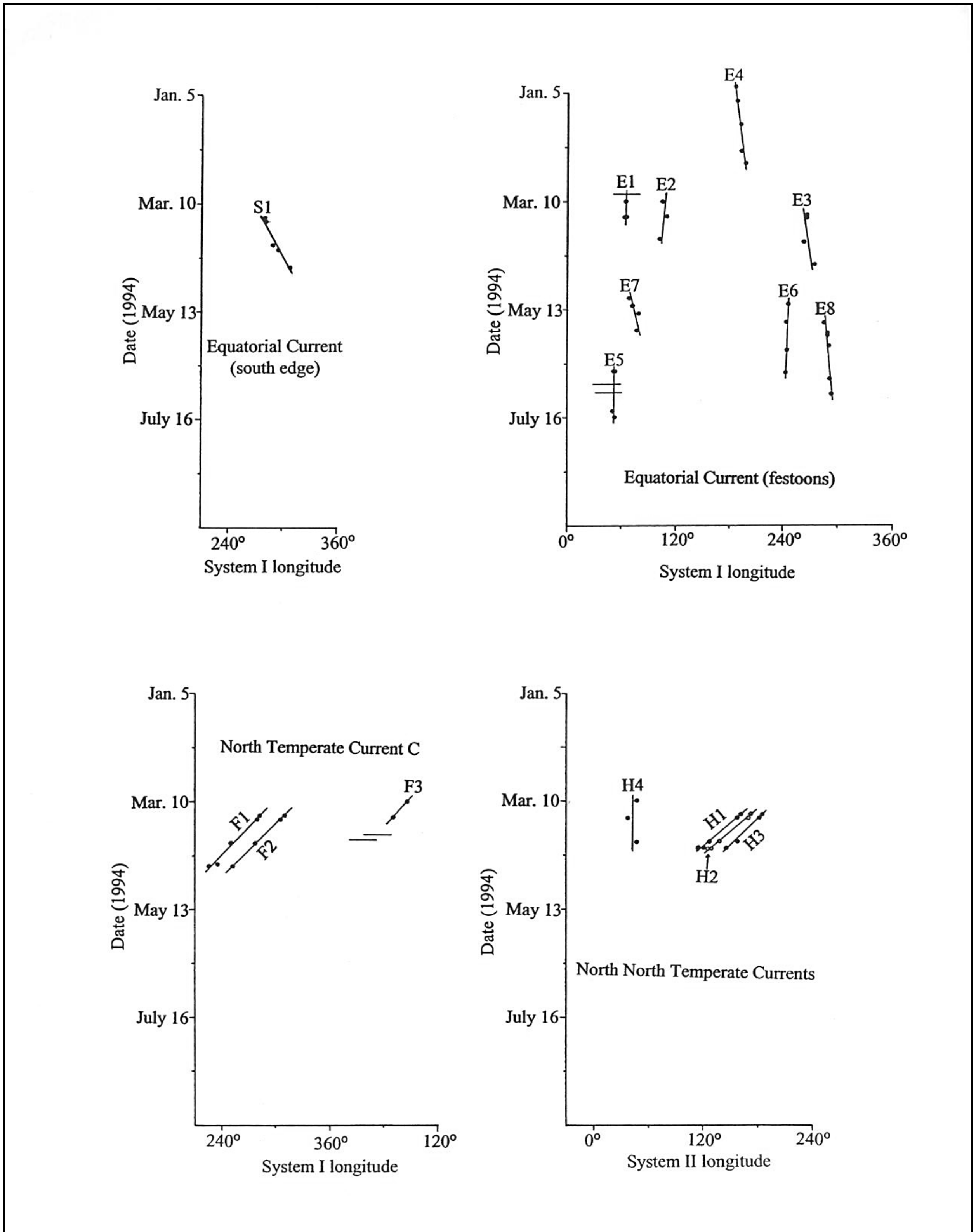

Figure 6: Longitudes for various features on Jupiter in 1994; symbols are the same as in Figure 5.

Table 8: Drift Rates of Features in System II Longitude in the 1995 Apparition of Jupiter

South South South Temperate Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
A1	6	May 13 – June 14	51°.1 S	-16.0	9h 55m 19s

South South Temperate Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
B1	4	May 13 – June 11	41°.6 S	-21.7	9h 55m 11s
B2	6	May 13 – July 3	42°.1 S	-25.1	9h 55m 06s
B3	5	May 16 – July 3	41°.1 S	-23.1	9h 55m 09s
B4	4	April 16 – June 15	41°.1 S	-22.8	9h 55m 09s
	Mean		*41°.5 S*	*-23.2*	*9h 55m 09s*

South Temperate Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
Oval FA*	13	May 13 – June 20	34°.6 S	-15.1	9h 55m 20s
Oval FA*	15	June 20 – Aug. 18	34°.0 S	-11.3	9h 55m 25s
Oval BC	13	May 13 – July 29	34°.9 S	-12.4	9h 55m 24s
Oval DE	19	May 13 – Aug. 27	34°.1 S	-11.3	9h 55m 25s
C1	15	May 7 – Aug. 27	32°.9 S	-11.4	9h 55m 25s
C2	5	May 13 – June 11	34°.4 S	-12.0	9h 55m 24s
C3	5	May 16 – July 3	34°.6 S	-11.2	9h 55m 25s
C4	12	June 16 – Aug. 13	32°.1 S	-13.3	9h 55m 23s
	Mean		*33°.9 S*	*-12.1**	*9h 55m 24s*

South Tropical Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
GRS	59	Feb. 12 – Sep. 28	23°.0S	+0.5	9h 55m 41s
C5	16	June 13 – Aug. 15	21°.9 S	+3.3	9h 55m 45s

North Equatorial Current (barges and/or projections)

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
N1	25	Mar. 20 – Aug. 3	16°.0N	+0.6	9h 55m 42s
N2	35	Feb. 12 – July 30	16°.0N	-3.7	9h 55m 36s
N3	5	May 13 – June 11	16°.0N	+4.7	9h 55m 47s
N4	7	May 13 – June 20	16°.0N	+5.9	9h 55m 49s
N5	7	May 11 – June 29	16°.0 N	-2.3	9h 55m 38s
N6	5	May 16 – July 11	16°.0 N	-0.9	9h 55m 39s
N7	9	June 3 – Aug. 3	16°.0 N	-1.1	9h 55m 39s
	Mean		*16°.0 N*	*+0.5*	*9h 55m 41s*

North Temperate Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
G1	5	May 13 – June 14	28°.6 N	+14.4	9h 56m 00s
G2	4	May 13 – June 11	28°.6 N	+8.8	9h 55m 53s
	Mean		*28°.6 N*	*+11.6*	*9h 55m 57s*

North North Temperate Current

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System II	Rotation Period
H1	6	May 13 – June 14	40°.8 N	+12.1	9h 55m 57s
H2	4	May 16 – June 14	41°.7 N	+1.3	9h 55m 42s
	Mean		*41°.3 N*	*+6.7*	*9h 55m 50s*

* Each of the two FA drift rates is given a weight of 0.5.

Table 9: Drift Rates of Features in the Equatorial Zone, and in the North Temperate Current C in the 1995 Apparition of Jupiter

Equatorial Current (Festoons)

Feature Ident.	Number of Points	Time Interval	Planetographic Latitude	Drift Rate (deg./30 days) System I	Rotation Period
E1	6	May 6 – May 30	5°.9 N	+0.2	9h 50m 30s
E2	13	May 2 – July 27	5°.9 N	-2.2	9h 50m 27s
E3	10	June 4 – July 27	5°.9 N	+0.2	9h 50m 30s
E4	5	July 4 – Aug. 5	5°.9 N	-1.7	9h 50m 28s
E5	7	Mar. 28 – July 11	5°.9 N	-0.9	9h 50m 29s
E6	14	July 6 – Aug. 25	5°.9 N	+4.3	9h 50m 36s
E7	6	July 24 – Sep. 5	5°.9 N	+9.3	9h 50m 43s
E8	6	July 23 – Sep. 5	5°.9 N	-1.5	9h 50m 28s
E9	5	May 13 – June 18	5°.9 N	-0.8	9h 50m 29s
	Mean		*5°.9 N*	*+0.8*	*9h 50m 31s*

North Temperate Current C

F1	6	June 9 – July 29	22°.9 N	-57.2	9h 49m 13s
F2	11	May 16 – Aug. 15	22°.9 N	-63.6	9h 49m 05s
F3	3	June 12 – July 9	22°.9 N	-64.2	9h 49m 04s
F4	3	June 12 – July 9	22°.9 N	-60.2	9h 49m 09s
F5	3	May 23 – June 15	22°.9 N	-56.7	9h 49m 14s
	Mean		*22°.9 N*	*-60.4*	*9h 49m 09s*

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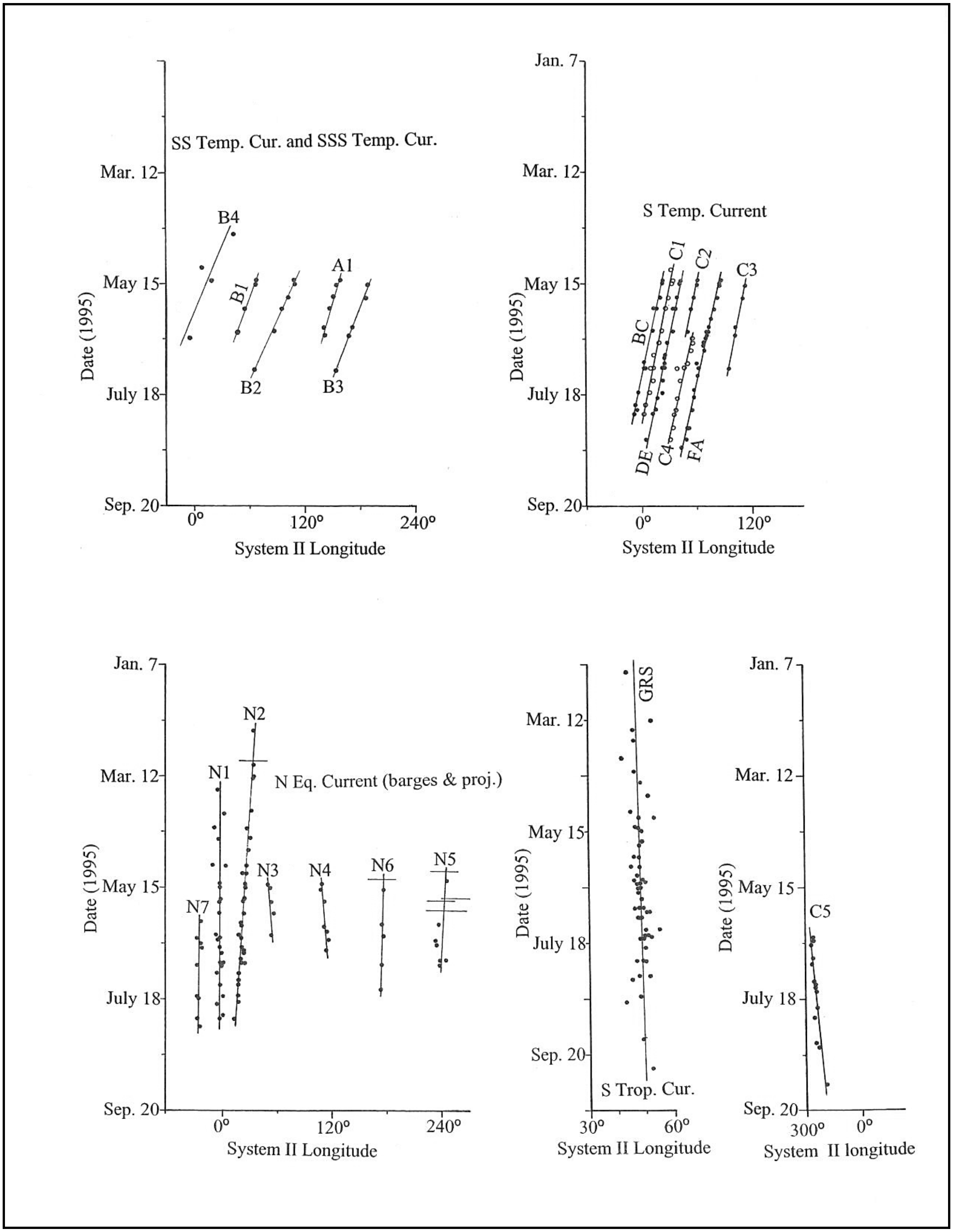


Figure 7: Longitudes for various features on Jupiter in 1995; symbols are the same as in Figure 5.

Table 10: (A): Mean Drift Rates, Rotation Periods and Wind Speeds for Several Currents on Jupiter, 1994 Apparition

Current	Feature(s)	Drift Rate (degrees/30 days)			Rotation Period	Wind Speed (m/sec.)[a]
		Sys. I	Sys. II	Sys. III		
SS Temp. Current	B1,B2	+202.5	-26.4	-18.4	9h 55m 05s	+6.7±0.2
S Temp. Current	Ovals FA,BC,DE	+215.8	-13.1	-5.1	9h 55m 23s	+2.1±0.4
S Trop. Current	GRS	+229.6	+0.7	+8.7	9h 55m 42s	-3.9±0.5[b]
S Trop. Current	C1	+228.3	-0.6	+7.4	9h 55m 40s	-3.3±0.9[b]
Equatorial Current southern branch	S1	+26.8	-202.1	-194.1	9h 51m 06s	+92.7±1.0
Equatorial Current (festoons)	E1-E8	+3.0	-225.9	-217.9	9h 50m 34s	+104.0±1.0
N Eq. Cur. (ovals)	N1,N2	+226.0	-2.9	+5.1	9h 55m 37s	-2.3±0.6
N Equatorial Current (barges)	N3-N5	+225.3	-3.6	+4.4	9h 55m 36s	-2.0±0.8
N Temp. Current C	F1-F3	-53.5	-282.4	-274.4	9h 49m 18s	+121.8±0.8
NN Temp. Current B	H1-H3	+161.4	-67.5	-59.5	9h 54m 08s	+23.9±1.1
NN Temp. Current	H4	+229.6	+0.7	+8.7	9h 55m 42s	-3.5±1.5[b]

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

Table 10: (B) Mean Drift Rates, Rotation Periods and Wind Speeds for Several Currents on Jupiter, 1995 Apparition

Current	Feature (s)	Drift Rate (degrees/30 days)			Rotation Period	Wind Speed (m/sec.)[a]
		Sys. I	Sys. II	Sys. III		
SSS Temp. Cur.	A1	+212.9	-16.0	-8.0	9h 55m 19s	+2.5±1[b]
SS Temp. Cur.	B1-B4	+205.7	-23.2	-15.2	9h 55m 09s	+5.6±0.3
S Temp. Cur.	Ovals BC,DE,FA, C1-C4	+216.8	-12.1	-4.1	9h 55m 24s	+1.7±0.2
S Trop. Cur.	GRS	+229.4	+0.5	+8.5	9h 55m 41s	-3.8±0.5[b]
S Trop. Cur.	C5	+232.2	+3.3	+11.3	9h 55m 45s	-5.1±0.5[b]
Eq. Cur. (festoons)	E1-E9	+0.8	-228.1	-220.1	9h 50m 31s	+105.3±0.6
N. Eq. Cur.	N1-N7	+229.4	+0.5	+8.5	9h 55m 41s	-3.9±0.3
N. Temp. Cur. C	F1-F5	-60.4	-289.3	-281.3	9h 49m 09s	+125.8±0.7
N. Temp. Cur.	G1,G2	+240.5	+11.6	+19.6	9h 55m 57s	-8.4±1[b]
NN Temp. Cur.	H1,H2	+235.6	+6.7	+14.7	9h 55m 50s	-5.5±1.4

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

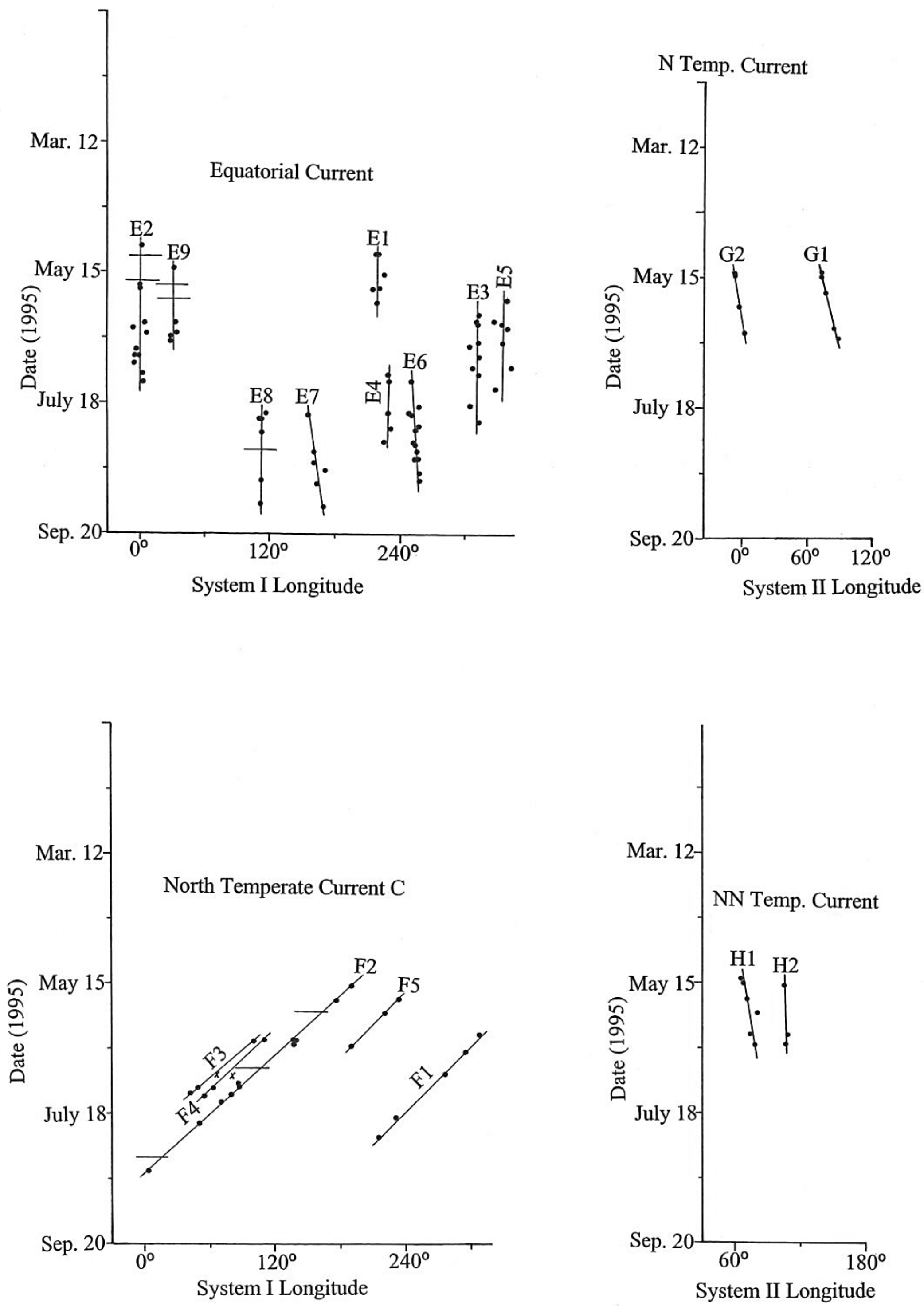
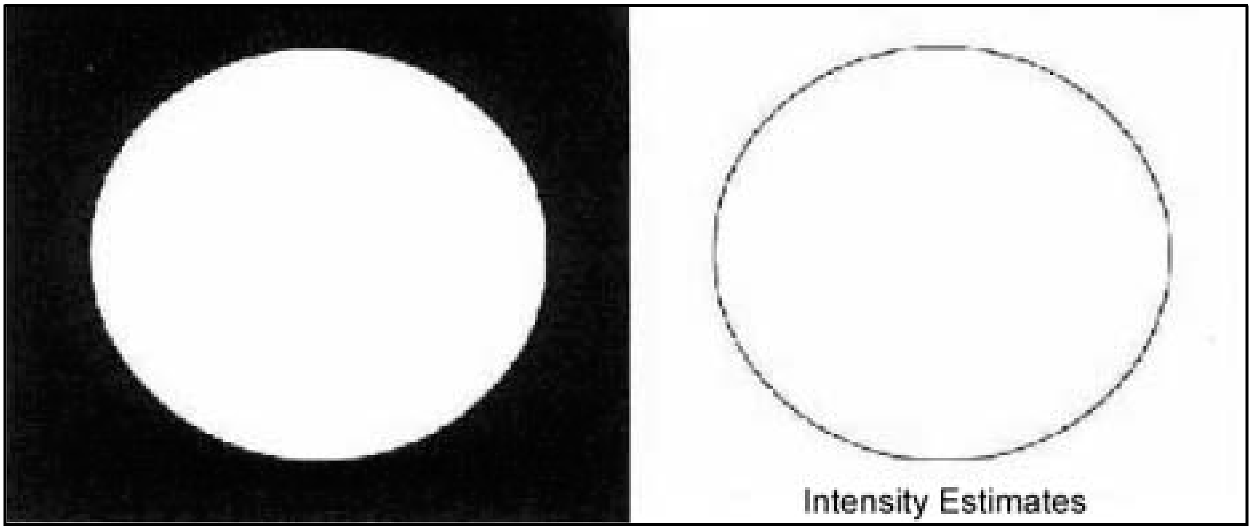


Figure 8: Longitudes for various features on Jupiter in 1995; symbols are the same as in Figure 5.

ALPO Jupiter Section Observation Form No. ______



Date (UT): ____ Name: ____

Time (UT): ____ Address: ____

CM I _____ CM II ____ CM III _______ ____

Begin (UT): ______________ End (UT) _____________ City, State, ZIP: ________________________________

Telescope: f/ ___ Size: ___________ (in./cm.; RL/RR/SC) ____

Magnification: _______x ________x ________x Observing Site: ________________________________

Filters: ___________________________________(W / S) ____

Trnasparency (1 - 5): ____ (Clear / Hazy / Int. Clouds) E-mail: ____

Seeing (1 - 10): _________ Antoniadi (I - V): _________

No.	Time (UT)	S I (°)	S II (°)	S III (°)	Remarks

Notes

Feature Story:
Visual Intensity Estimates of Low Latitude Features on Saturn, 1947-2004

By Walter H. Haas,
ALPO Founder and Director Emeritus
haasw@zianet.com

Abstract

The writer made visual numerical intensity estimates of the South Equatorial Belt, the Equatorial Zone, the Equatorial Band, and the North Equatorial Belt on Saturn over the interval 1947-2004. Telescopes employed were, with very few exceptions, a 32-cm reflector, a 20-cm reflector, and a 15-cm reflector — all Newtonians. From 1962 onward, the estimates were all on a standard intensity scale and almost all with the 20-cm and 32-cm telescopes. The earlier observations were converted to the same scale. There were in all about 900 sets of intensity estimates, though the changing tilt of the axis of Saturn made many of the features unobservable for years at a time. The study was limited to personal observations in the hope of minimizing systematic errors. The results are presented in tables and graphs, with suggestions about their interpretation. *Figure 1* describes the various features of this planet with abbreviations used throughout the text.

Introduction and Intensity Scales

Saturn might well be described as that beautiful planet on which nothing much happens. The ordinary casual view is indeed monotonously the same from night to night and even from year to year, quite the opposite of what we find on its larger cousin, Jupiter. The 1990 Equatorial Zone Great White Spot is, to be sure, a recent rare exception [6]. One may wonder whether closer attention might reveal more activity. In truth, the much improved resolution on the best of current digital images has disclosed details which would have gone unrecorded in the past.

The novice is probably content to call lunar and planetary features bright , dark, faint, conspicuous, etc. Our visual work can become more quantitative when we adopt numerical scales. The best-known example is surely Elger's lunar scale of 0 for shadows to 10 for the brilliant central peak of Aristarchus. In 1947, I began to estimate intensities of features on Saturn on a scale of 0 for the most brilliant features on the globe or in the rings to 10 for shadows in optimum views. In 1962, I changed to the ALPO Standard Scale of 0 for shadows to 10 for the very brightest objects, with this calibration: the outer one-third of Ring B is arbitrarily set to intensity 8.0. This feature is dimmer when the rings are almost on edge, leaving us with less of a standard; and British Astronomical Assn (BAA) observers have proposed a modification on their different scale [5].

In this paper, the estimates before 1962 are converted to the ALPO Scale with the formula:

$$I(new) = 10.0 - I(old)$$

where I(new) is the intensity on the ALPO Scale and I(old) on the previous one. It is appreciated that this relation is an arbitrary one.

Though the scale chosen contained only 10 integral units, I soon began to make estimates to half-units and later to one-fourth units. Eventually intensity observations were recorded to one-tenth of a unit. There is certainly no claim of recognizing 100 different tones in the image of Saturn. However, the statistical analysis (see *Table 1, Table 2 and Table 3*) would suggest that the standard deviation of a single intensity estimate of a feature was often around 0.1 or 0.2 units. Of course, systematic errors, and certainly the "personal equation" of different visual observers, may be much larger. There are also effects of aperture, optical quality of the telescope, atmospheric seeing and transparency, altitude of Saturn above the horizon, etc. John Westfall has pointed out that the sensitivity of my eye may have varied over the years of this study, though a statistical test is inconclusive [7]; and a more troublesome question is whether the brain would always assign the very same intensity number to the very same intensity tone on Saturn.

When satellite Titan is occasionally viewed in transit across Saturn, it looks very dark against its background, even being taken for a shadow. Now the geometric albedo of Saturn is 0.47; that of Titan is

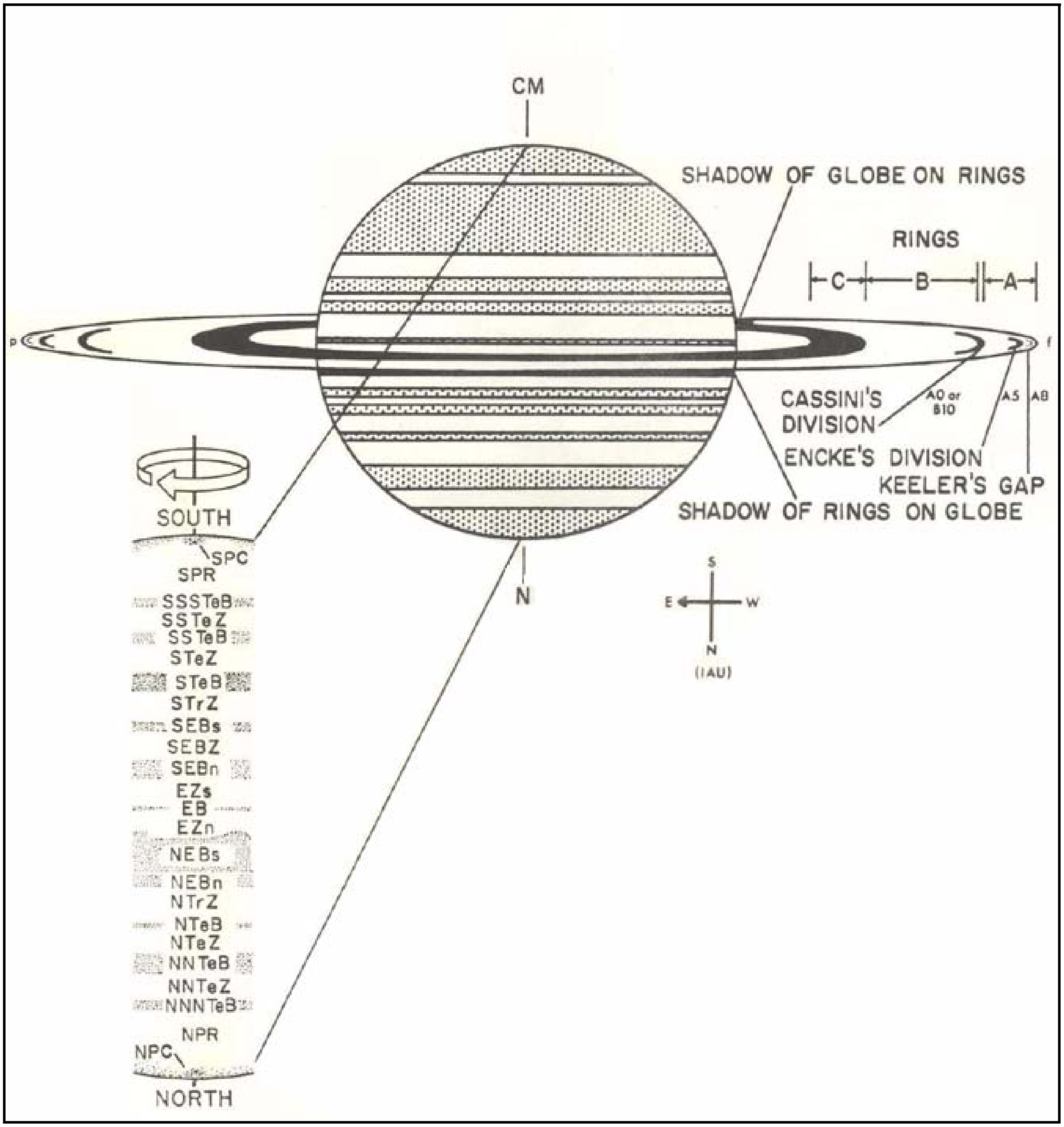


Figure 1. General Nomenclature of Features of Saturn. Globe features include (from north to south) NPC = North Polar Cap; NPR = North Polar Region; NNNTeB = North North North Temperate Belt; NNTeB = North North Temperate Zone; NNTeB = North North Temperate Belt; NTeZ = North Temperate Zone; NTeB = North Temperate Belt; NTrZ = North Tropical Zone; NEBn = North Equatorial Belt (north); NEBs = North Equatorial Belt (south); EZn = Equatorial Zone (north); Equatorial Belt; EZs = Equatorial Zone (south); SEBn = South Equatorial Belt (north); SEBZ = South Equatorial Belt Zone; SEBs = South Equatorial Belt (south); STrZ = South Tropical Zone; STeB = South Temperate Belt; STeZ = South Temperate Zone; SSTeB = South South Temperate Belt; SSTeB = South South Temperate Zone; SSSTeB = South South South Temperate Belt; SPR = South Polar Region; SPC = South Polar Cap. A, B and C (Crepe) are Ring designations, while Cassini (A0 or B10), Encke's (A5) and Keeler (A8) refer to Ring divisions (intensity minima).

0.22 [1]. This result would suggest for the ALPO Scale, just roughly, numerical intensities of 0 for well-seen shadows, perhaps 2 for Ring C and its shadow as projected on the globe, say 3 for the darker belts (to match Titan?), around 5 for most of the globe (to match the average tone of Saturn), 6 or 7 for the brightest zones and Ring A near the ansae, and 9 or 10 for rare brilliant outbursts in the Equatorial Zone of the planet.

Table 1: Intensity Observations of the North Equatorial Belt of Saturn, north component NEBn, south component NEBs, and whole belt NEBw

Apparition	NEBn	NEBs	NEBw
1947-48			4.26+/-0.05
1948-49			3.95+/-0.04
1949-50	3.56+/-0.06	3.12+/-0.06	3.14+/-0.08
1951-52	3.46+/-0.07	2.54+/-0.10	
1954-55	3.89+/-0.04	2.97+/-0.05	
1955-56	3.90+/0.04	3.15+/-0.03	
1957-58	3.71+/0.07	3.12+/-0.10	
1958-59	3.91+/0.04	3.54+/-0.10	
1959-61	3.92+/0.06	3.51+/-0.09	3.60+/-0.10
1962-63			3.08+/-0.14
1963-64	3.20+/-0.07	2.47+/-0.09	3.07+/-0.07
1964-65	3.18+/-0.02	2.64+/-0.06	3.06+/-0.06
1965-66	3.21+/-0.03	2.80+/-0.05	3.04+/-0.07
1966-67	3.11+/-0.02	2.83+/-0.03	3.11+/-0.03
1967-68			3.70+/-0.08
1982-83	3.12+/-0.08	2.50+/-0.11	
1983-84	3.22+/-0.06	2.95+/-0.06	3.22+/-0.04
1985-86	3.35+/-0.03	2.84+/-0.04	3.29+/-0.05
1986-87	3.60+/-0.02	3.30+/-0.03	3.42+/-0.06
1987-88	3.42+/-0.02	3.02+/-0.02	3.48+/-0.02
1988-90	3.47+/-0.05	3.35+.-0.05	3.52+/-0.02
1990-91	3.56+/-0.02	3.24+/-0.02	3.43+/-0.02
1991-92	3.27+/-0.05	3.00+/-0.06	3.51+/-0. 05
1992-93	3.28+/-0.03	2.96+/-0.03	3.30+/-0.03
1993-94	3.30+/-0.09	2.88+/-0.08	3.27+/-0.03
1994-95			3.22+/-0.05
1995-96	3.40+/-0.06	2.93+/-0.12	3.16+/-0.03
1996-97			3.51+/-0.07
1997-98			3.71+/-0.03

BAA observers have carried out for the interval 1943-1981 a study of all ring and globe features with perhaps about 4 times as many observations of the 10 selected features (see below) as were available in this paper. [3,4,5]. Our goal is limited to detecting intensity changes in major features in low latitudes. This effort may be justified on the basis of the elimination of "personal equation", the use of very largely the same few telescopes, and a longer and more recent interval of observation.

Major Detail and Changing Axial Tilt

The most obvious features present on Saturn are regularly a bright Equatorial Zone and two dark belts at its edges, the South Equatorial Belt on its south boundary and the North Equatorial Belt on its north boundary. (Though the two are very probably always PRESENT, frequently only one of them can be OBSERVED from the Earth - see below).

The SEB is often resolved into north and south components, and many observations at least show darker north and south edges. Sometimes the SEB appears a single, simple belt. The same remarks apply to the NEB.

A faint, dusky Equatorial Band is sometimes recorded near the middle of the EZ. Current excellent CCD images would suggest for the EB a more complex structure. When the EB is present or when the projected rings are seen against the EZ, it is convenient to think of it as composed of north and south parts, an EZn and an EZs. At moderate or large southern tilts of the axis, a recorded EZ is likely to be the EZs; at moderate or large northern tilts, the EZn. (The rings can occult large parts of the globe for years at a time.)

The Saturnicentric latitude of the Sun, or B', varies from 26.7 degrees south to 26.7 degrees north in Saturn's "year" of 29.4 Earth years; and B, the Saturnicentric latitude of the Earth, is always close to the value of B'. The effect on the appearance of a particular feature is considerable. The mean Saturnicentric latitudes of the centers of the belts included in this study, according to Hollis [4], are given here (as usual, north is +; south is -).

- NEBn +20.9 degrees
- NEBs +13.7
- EB -2.2
- SEBn - 13.9
- SEBs -23.7

When the south tilt of the axis is large, as at present, the SEB will be conspicuous near the latitudinal middle of the globe. At northern tilts, it will be far from this middle and will even be unobservable. The NEB is inconspicuous or unobservable at large southern tilts of the axis; the SEB, at large northern tilts. It should be noted that Saturn is north of the Earth's equator at medium or large southern tilts, and south of it at medium or large northern tilts, so that we might expect better viewing conditions and better data on the SEB than on the NEB.

Our study of possible long-term intensity changes in features on Saturn thus is largely limited to ones in low latitudes. We shall choose these 10 belts or zones:

- the SEBs
- the entire SEBw
- the SEBn
- the EZs
- the entire EZw
- the EB
- the EZn
- the NEBs
- the entire NEBw
- the NEBn

The entire SEB or NEB may often be recorded when the view is too poor or the axial tilt too unfavorable, to resolve the two components.

The Observations

It is convenient to divide observations of Saturn into APPARITIONS, where an apparition is defined as the period during which the planet can be observed and, in concept, extends from one conjunction with the Sun to the immediately following one. Thus the 2003-04 apparition is the interval from the conjunction on 2003 June 24 to the next one on 2004 July 8, though it is likely that the most and the best observations will fall near the intervening opposition on 2003 December 31.

I began to make these intensity estimates with a 15-cm, f/7.9 reflector at Albuquerque, NM. In 1950, I moved to Las Cruces, NM, where I have since remained, except for an interval in Edinburg, TX, in 1959-62. In 1954, I acquired a 32-cm, f/8.1 Cave reflector, which was subsequently my chief instrument. In 1985, I obtained a 20-cm, f/8.0 Criterion Dynascope, which became an alternate telescope. All three are Newtonians. Magnifications employed have almost always fallen in the range from 188X to 366X.

Table 2: Intensity Observations of the South Equatorial Belt of Saturn, north component SEBn, south component SEBs, and whole belt SEBw

Apparition	SEBn	SEBs	SEBw
1946-47	2.98+/-0.05	3.66+/-0.05	
1947-48	3.07+/-0.03	3.40+/-0.04	3.38+/-0.12
1948-49	3.39+/-0.06	3.83+/-0.02	3.75+/-0.09
1949-50	3.18+/-0.04	3.83+/-0.03	3.69+/-0.05
1951-52			3.94+/-0.04
1963-64			3.74+/-0.09
1964-65			3.61+/-0.05
1965-66	3.10+/-0.05	3.48+/-0.05	3.38+/-0.05
1966-67	2.97+/-0.03	3.27+/-0.02	3.30+/-0.03
1967-68	2.50+/-0.08	3.04+/-0.07	
1969-70	2.68+/-0.13	3.15+/-0.06	
1970-71	2.80+/-0.04	3.32+/-0.02	
1971-72	2.98+/-0.07	3.44+/-0.05	
1972-73	2,94+/-0.03	3.35+/-0.03	3.06+/-0.09
1973-74	3.01+/-0.04	3.61+/-0.07	
1974-75	2.90+/-0.08	3.39+/-0.06	
1975-76	2.78+/-0.04	3.38+/-0.05	
1976-77	2.95+/-0.03	3,51+/-0.02	
1994-95			3.60+/-0.04
1995-96			3.46+/-0.02
1996-97			3.18+/-0.08
1997-98	2.49+/-0.04	3.11+/-0.02	
1998-99	2.65+/-0.04	3.23+/-0.04	
1999-2000	2.80+/-0.05	3.34+/-0.05	
2000-01	2.72+/-0.03	3.35+/-0.03	
2001-02	2.86+/-0.09	3.41+/-0.06	
2002-03	3.05+/-0.09	3.80+/-0.08	
2003-04	3.10+/-0.07	3.66+/-0.07	

The observational coverage of each of the 10 selected features varied greatly from apparition to apparition, from no data at all to a maximum of 87 estimates, as personal circumstances and observing priorities varied. In reducing the data, it was decided

Table 3: Intensity Observations of the Equatorial Zone of Saturn, north part EZn, south part EZs, whole zone EZw, and Equatorial Band EB

Apparition	EZn	EZs	EZw	EB
1946-47			8.58+/-0.13	4.75+/-0.14
1947-48	8.57+/0.30	7.63+/-0.31	7.86+/0.09	4.50+/-0.16
1948-49	8.63+/-0.08	7.38+/-0.13	8.22+/-0.10	4.33+/-0.17
1949-50	8.31+/-0.09	6.95+/-0.12	7.91+/-0.09	3.75+/-0.25
1951-52			7.61+/-0.22	4.50+/-0.00
1954-55			7.93+/-0.18	4.71+/-0.07
1955-56			7.38+/-0.18	4.2
1957-58			6.66+/-0.31	4.50+/-0.00
1958-59			7.85+/-0.12	4.8
1959-61			6.87+/-0.14	4.50+/-0.00
1961-62				4.5
1962-63			7.98+/-0.41	4
1963-64			8.21+/-0.42	4.10+/-0.23
1964-65	7.48+/-0.23	7.14+/-0.11	8.08+/-0.36	3.87+/-0.07
1965-66	7.91+/-0.18	7.12+/-0.17		3.8
1966-67	6.86+/-0.09	8.65+/-0.04		
1967-68	5.97+/-0.12	8.49+/-0.17		
1968-69				4
1969-70			7.75+/-0.26	3.90+/-0.10
1970-71			6.68+/-0.18	3.8
1971-72			5.92+/-0.28	4.03+/-0.03
1972-73			6.15+/-0.14	3.75+/-0.05
1973-74			6.62+/-0.12	3.88+/-0.09
1974-75			6.71+/-0.15	3.90+/-0.10
1975-76			7.27+/-0.14	3.73+/-0.08
1976-77			7.39+/-0.17	4.00+/-0.07
1982-83			6.66+/-0.09	
1983-84			5.99+/-0.07	
1985-86			6.17+/-0.03	4.3
1986-87			6.36+/-0.03	4.2
1987-88			7.24+/-0.10	4.05+/-0.15
1988-90			6.66+/-0.07	
1990-91			6.77+/-0.06 *	4.20+/-0.20
1991-92			6.44+/-0.06	
1992-93			6.53+/-0.02	4.21+/-0.04
1993-94			6.60+/-0.10	
1994-95	6.31+/-0.06	6.38+/-0.09		3.7
1995-96	6.39+/-0.05	6.35+/-0.06		4.09+/-0.08
1996-97	5.88+/-0.08	6.81+/-0.08		
1997-98	5.28+/-0.04	6.17+/-0.04	6.38+/-0.11	4.24+/-0.04
1998-99			6.25+/-0.03	3.95+/-0.07
1999-2000			6.31+/-0.06	3.97+/-0.04
2000-01			6.37+/-0.08	4.11+/-0/06
2001-02			6.48+/-0.07	4.29+/-0.06
2002-03			6.70+/-0.13	4.17+/-0.03
2003-04			7.05+/-0.03	4.25+/-0.05

* These numbers refer to the part of the EZ not covered by the very prominent Great White Spot of 1990. For the greatly variable Spot itself the values are 7.99+/-0.15. Its brightness varied as it faded.

to ignore apparitions in which a feature was observed less than three times. There was this exception, however; all observations were used for the difficult and poorly-observed EB.

It is recognized, of course, that a belt or zone may vary in intensity in different longitudes of Saturn. It may also change with time. Further, the presence of brighter or darker internal features, perhaps not themselves detected, may affect the observed intensity of the whole feature.

Table 1, *Table 2*, and *Table 3* each list the observations of each feature studied during each apparition when it was adequately studied. The mean value is given, along with the standard deviation of that mean value. (The latter is missing for the EB when there was only one observation.). As is usual, a very small number of the observations were discordant and had to be rejected.

The values for the NEB features in *Table 1* are plotted and connected in *Figure 2*. Each plotted point is the mean value of that feature for that apparition, and the vertical bar is the standard deviation of the mean value. When there was a gap of a single point between two consecutive plotted points of a particular feature because of the lack of enough observations, the computer program calculated and plotted their midpoint and provided no error bar. When there was a longer gap, the preceding and following data points were not connected. On *Figure 2* the apparitions with zero tilt (rings on edge) are marked with an O, those with the maximum northern tilt of the rings (largest positive B) with an N, and those with a maximum southern tilt (numerically largest negative B) with an S. An X marks the apparition when the eventual standard method of intensity estimates was adopted.

Figure 2 appears to show the NEB to be darkening as the axial tilt became north in 1950 and 1979-80 and to reach its minimum intensity in about 1953 and 1983 respectively, subsequently fading. There

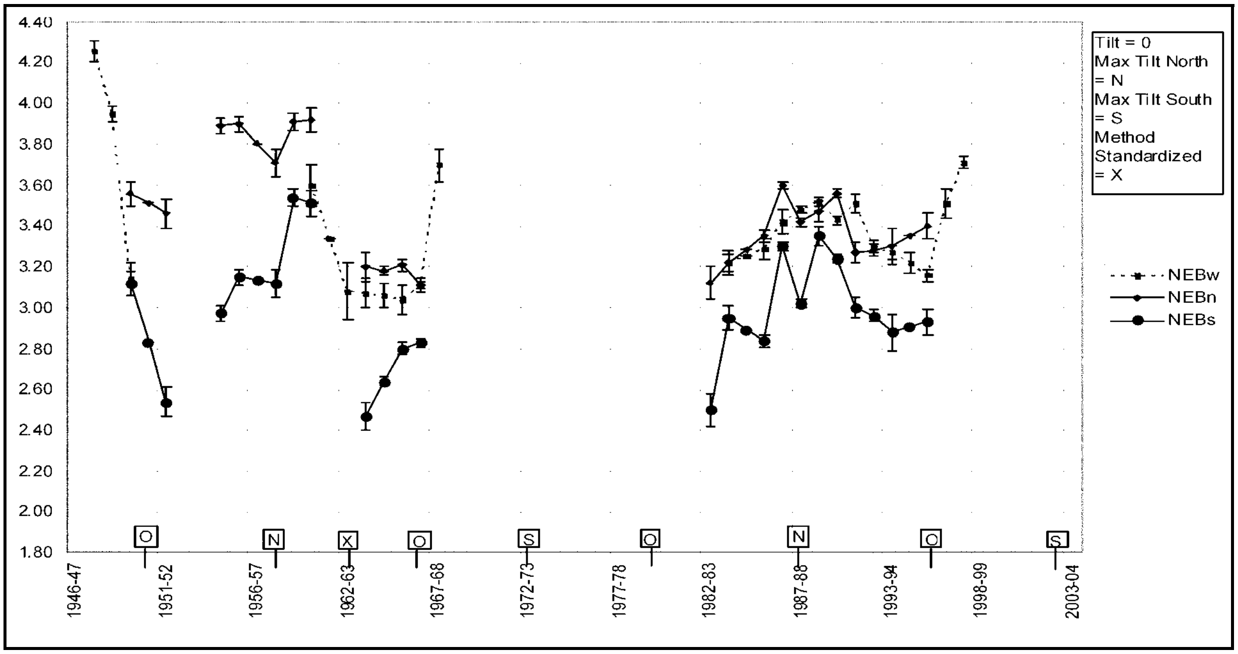


Figure 2. Intensity on ALPO scale of North Equatorial Belt of Saturn vs. Apparition.

are hints of possible other minima in about 1965 and 1994.

It should be remembered that Saturn was at southern declinations, and hence lower in the sky, for almost all the data plotted here.

The values of the SEB features are plotted and connected in *Figure 3*, and the remarks about *Figure 2* apply.

Inspection shows that the SEB was darkening as the axial tilt changed to south in 1966 and 1995 respectively, and reached maximum darkness (intensity minimum) in about 1968 and 1997 and then faded. Less definite is a suggestion of a similar fading from a darkness minimum in 1947 or earlier, and even less definite is a possible minimum in about 1976 The two SEB components appear to change together. The data do not appear to be symmetric about the time of greatest southern tilt in 1973 on Figure 3; the

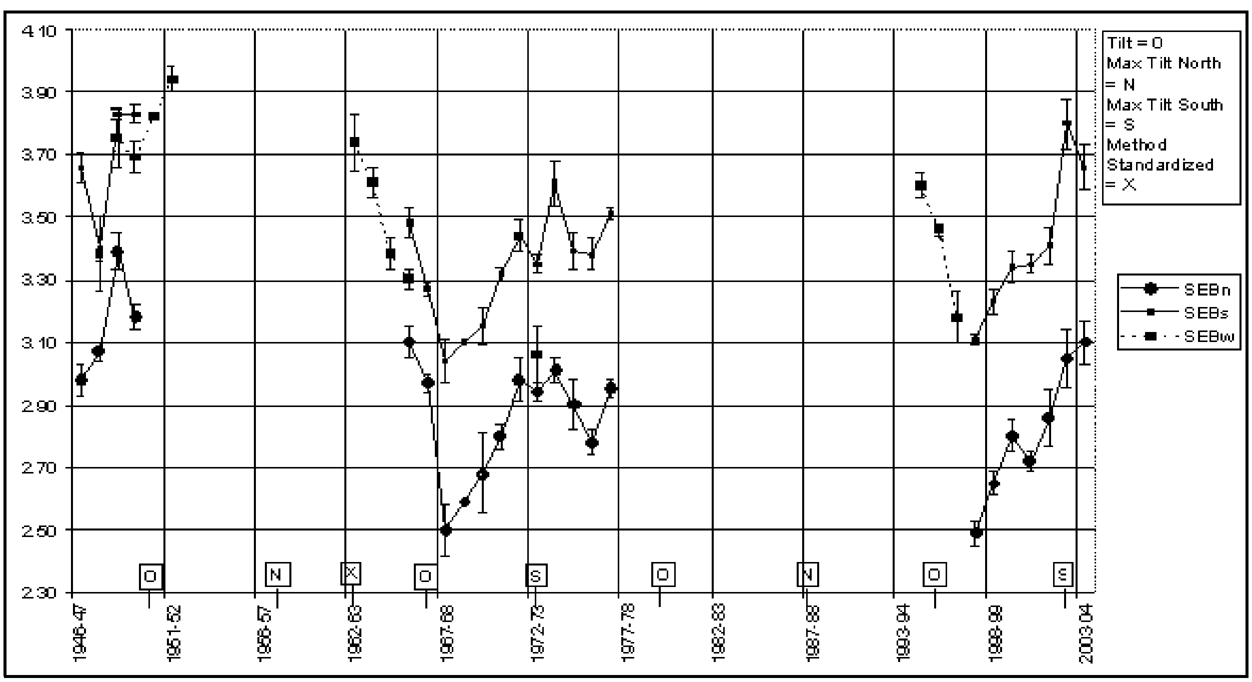


Figure 3. Intensity on ALPO scale of South Equatorial Belt of Saturn vs. Apparition.

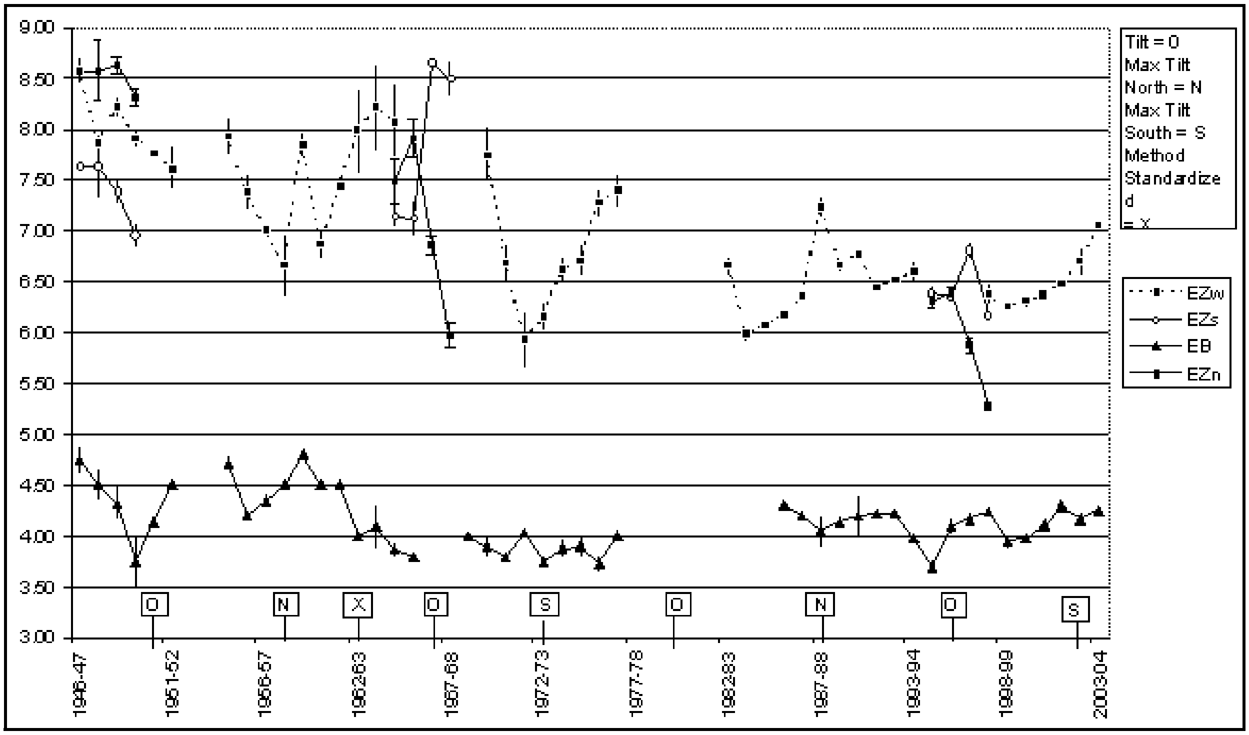


Figure 4. Intensity on ALPO scale of Equatorial Zone and Equatorial Band of Saturn vs. Apparition.

observed intensity is apparently not the same for the same tilt value before and after that maximum. It was hence decided to plot all the observed SEB apparition intensities against the DIFFERENCES of the tilt B at opposition from the maximum southern value of B', calling this difference negative before that maximum and positive afterwards. For example, in the 1998-1999 apparition, the tilt at opposition was -15.3

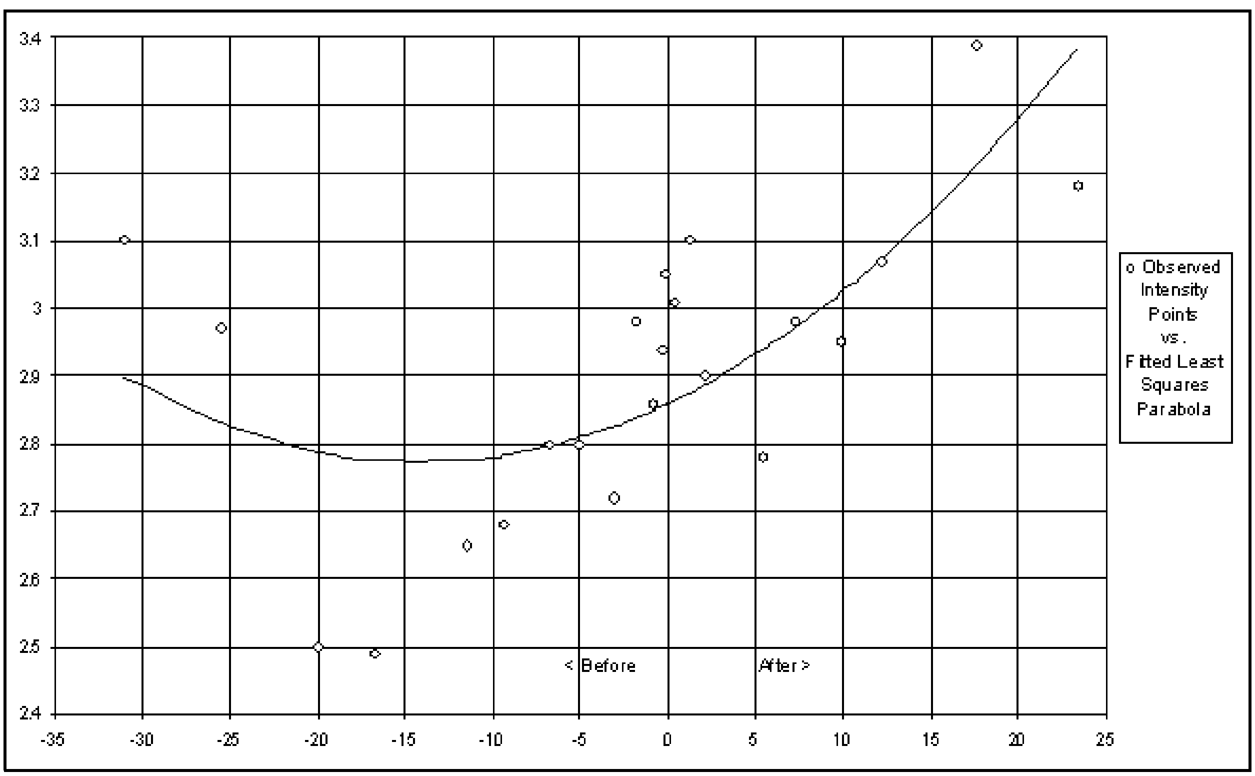


Figure 5. Observed Apparition Intensities of SEBn vs. Axial Tilt Differences from Maximum Tilt in Degrees, Before (-) and After (+).

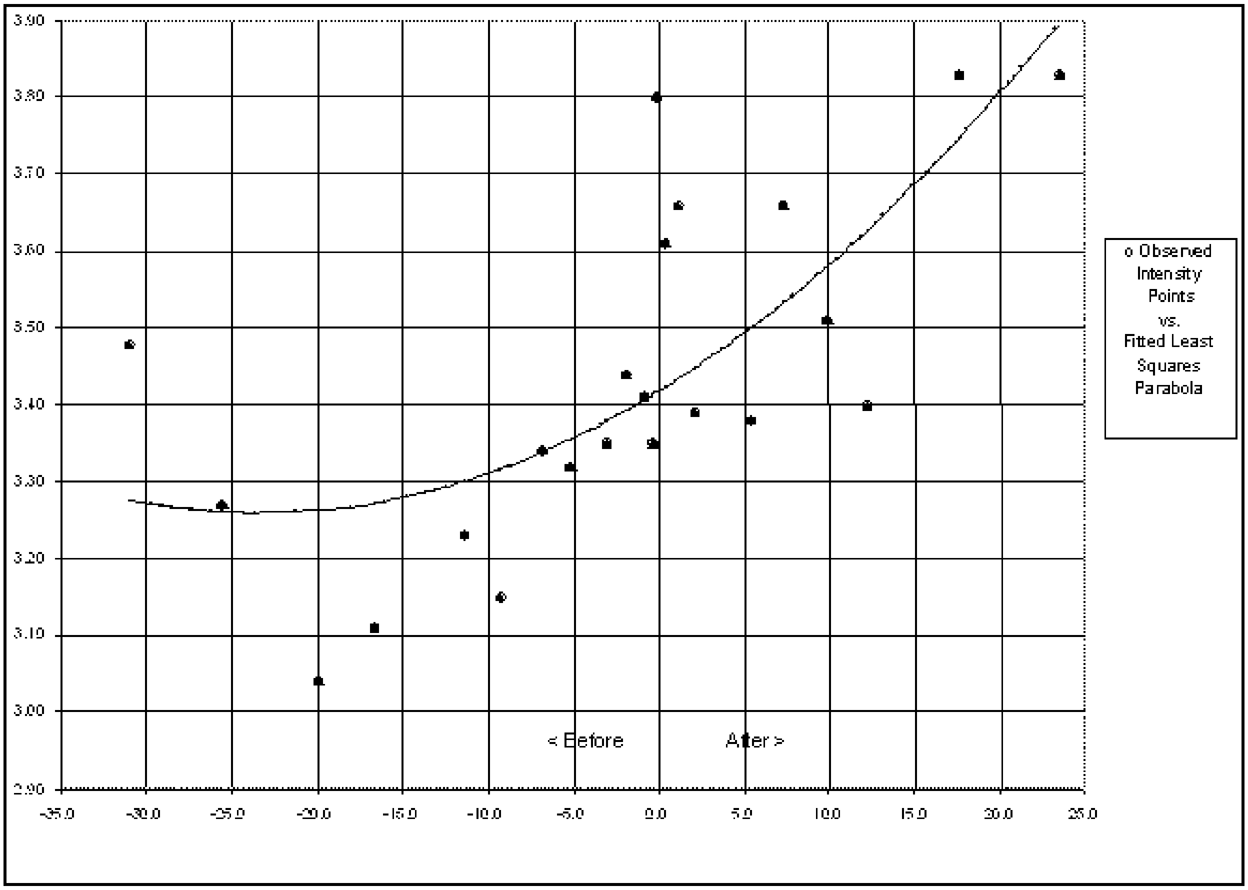


Figure 6. Observed Apparition Intensities of SEBs vs. Axial Tilt Differences from Maximum Southern Tilt in Degrees, Before (-) and After (+).

degrees. The difference from the LATER numeric maximum in 2003 of -26.7 degrees is -11.4 degrees, negative because later.

We shall later look at a fitting Least Squares Parabola in *Figure 5* and *Figure 6* from a statistical point of view.

The values for the EZ features are plotted and connected in *Figure 4*, and the description in *Figure 2* applies, except that data for the difficult EB are plotted even when there is only one observation in an apparition.

We here appear to have a brighter EZ and a less dark EB (larger intensity numbers) before 1962 than afterwards, but I think that this result is only a bias caused by the change of intensity scale in 1962. It should be realized that the feature called the EZ was often actually chiefly the EZn at northern tilts of the axis and similarly the EZs at southern tilts. The features shown may easily vary by random amounts, but trends appear to be lacking in my opinion. The occasional brighter patches observed and imaged in the EZ, especially in recent years, may explain this behavior.

Some Tentative Interpretations

The most obvious conclusion from an inspection of *Figure 2*, *Figure 3*, and *Figure 4* is that the features studied did not vary much in intensity. The SEB features were in general observed to be darker when the Saturnicentric latitude of the Earth was south; the NEB features, when it was north. Of course, a change related to different geometry may not indicate any physical change on the surface of Saturn.

Westfall has carried out a statistical analysis of our data [*7*], where the mean apparition intensities are regarded as functions of the signed differences in tilt B from a maximum value. He included the pre-1962 observations. For the SEBn in *Figure 5* the 1st order coefficient was significant at the 1 percent level, and the 2nd order coefficient was very nearly significant at that level. In other words, the probability of a parabolic fit due to chance is (very nearly) less than 0.01. For the SEBs in *Figure 6*, the linear coefficient is significant at the 1 percent level; but the quadratic coefficient is not significant at even the 5 percent level. For the NEBs and the NEBn, the fit is not significant at even the 5 percent level, and no plot was made. It was not thought worthwhile to apply this test to the EZ and the EB.

I made a more casual study of the Least Squares Parabola in *Figure 5*. There resulted a standard deviation of 0.155 intensity units for an observed point and a tilt difference at the intensity minimum of -14.1 degrees, making B = -12.6 degrees. If all observations before 1962 are omitted because of the change in method described above, there is no meaningful change in the fitted curve; the standard deviation becomes 0.152 units, and B at minimum is -13.4. degrees.

I made a similar study of the Least Squares Parabola in *Figure 6*. The standard deviation is 0.153, and the maximum darkness falls at B = -3.3 degrees. If we ignore all observations before 1962, the standard deviation is 0.151; and the intensity minimum is at B = -8.4 degrees. It might be noted on *Figure 3* that the separation in intensity of the SEB components on the plot does not vary much.

It is valuable to compare our results to the McKim and Blaxall BAA study of 1943-81 observations [*4 and 5*], a detailed analysis of many more observations than we have here. A direct comparison is very difficult because of the use of different intensity scales.

The BAA results and my estimates coexist from 1947 to 1977. McKim and Blaxall present good evidence that low latitude belts darken, and EZ features brighten, when the solar radiation upon Saturn is most direct. The Sun can never be in the zenith for Saturnicentric latitudes numerically greater than 22 degrees [*4*]. For features at lower latitudes, presumably including the SEBn and the NEBs, the Sun will be in the zenith twice during a Saturn "year", thus producing two darkness maxima (intensity minima on the ALPO Scale). This relation is very well shown in graphs in the McKim paper. The observations of the SEBn in this paper confirm a BAA maximum in about 1968, perhaps confirm a second one in about 1976, and may be compatible with an earlier maximum in about 1947. For the NEBs, they may confirm a darkness maximum in about 1953 and possibly another in about 1965. At the higher, but perhaps slightly variable, latitudes of the SEBs and the NEBn, the Sun may never be in the zenith, and there are less definite darkness maxima from this cause.

The data here may also be compared to the ALPO intensity observations in 1966-1996, as analyzed and plotted by Julius Benton [*2*]. The ALPO apparition mean intensities could actually be found in Dr. Benton's regular Saturn Reports in many old issues of this Journal, and might in concept allow the determination of my personal equation for these estimates; however, the two sets are not truly independent since I was one of the contributors to the ALPO records.

The Benton plots show wavy curves with mostly small peaks and troughs. Numeric intensity differences between consecutive apparitions may have no statistical significance. For the SEBn, the ALPO data support the darkness maximum in about 1968 cited above and may confirm the one in about 1977. For the SEBs, they show apparent maxima in about 1974, 1976, and 1978; *Figure 3* may weakly confirm the first two of these. It looks as if the NEBn was darkest in about 1986 and fainter from 1988 on; *Table 1* and *Figure 2* may give some support to the latter lightening. It must be appreciated that this discussion centers on small changes of perhaps less than one-half intensity unit.

The three sets of observations do not agree well on the EZ features. The BAA work makes the EZ components brightest near the ring edgewise presentations in 1950, 1966, and 1979-80. They found the EZn and the EZs equally bright on the average in 1950, but in the two later apparitions, the EZn was notably the dimmer. The EB tended to darken as the rings opened. The EZn and the EZs in the Benton plots [*2*] show cyclic changes not clearly related to the ring aspect, with the latter becoming dimmer after 1966. My own efforts would give the whole EZ an intensity minimum near 1970, 1984, and perhaps 1999. Any trends for the EB are really uncertain. See also *Figure 4*.

Yes, things do happen on Saturn. However, mean apparition intensities from a certain group of observers using a particular set of telescopes in various places may falsely differ from those obtained one or two apparitions later by a partially or wholly different group of observers with a different group of telescopes and in other places. We surely would NEVER want to discourage group observational studies of this kind, but statistical testing of differing values and determination of personal equations of observers would be most valuable.

Acknowledgements

We heartily congratulate Messrs. McKim and Blaxall on their classical paper [*3, 4,and 5*], with its analysis of a very large number of observations and its insight into physical and geometric relationships. Modern technologies may soon enough replace such photometry research with greatly improved methods. In the meantime we hope that this paper may possess some historical interest.

It is a pleasure to thank Mr. J. O. Hughes of Las Cruces, NM, for his very considerable help with the plots in this paper, and for his very considerable patience as well! Thanks are also expressed to Dr. John Westfall for his valuable criticism of parts of this paper.

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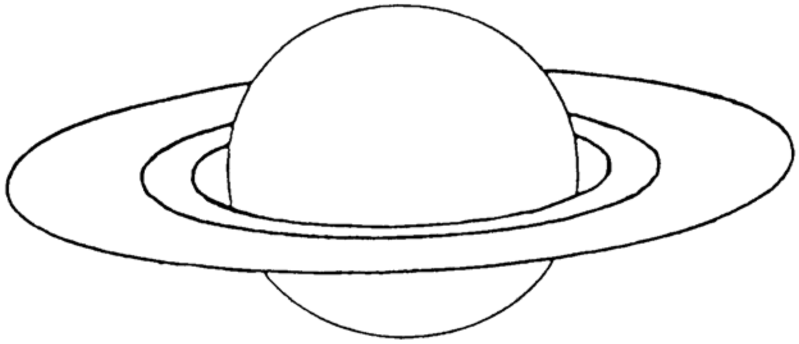
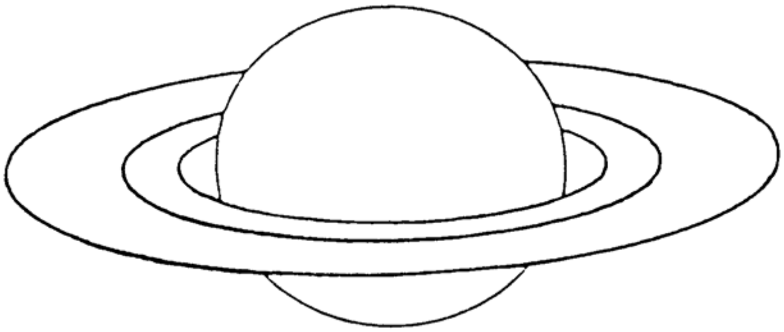
A.L.P.O. Visual Observation of Saturn for B = –14° to –16°

S





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B = _________° B′ = _________° Instrument ____ Magnification(s) _________ x_{min} _________ x_{max}

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Saturn Global and Ring Features	Visual Photometry and Colorimetry IL	f_1	f_2	f_3	Absolute Color Estimates	Latitude Estimates ratio y/r

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- Acting Assistant Coordinator (Section); Dr. P. Clay Sherrod, Arkansas Sky Observatory, Conway Offices, 794 Drake Drive, Conway, AR 72034
- Assistant Coordinator & Scientific Advisor; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706
- Assistant Coordinator, Transit Timings; John McAnally, 2124 Wooded Acres, Waco, TX 76710
- Assistant Coordinator, Newsletter; Craig MacDougal, 821 Settlers Road, Tampa, FL 33613
- Assistant Coordinator, Galilean Satellites; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447
- Scientific Advisor; Prof. A. Sanchez-Lavega, Dpto. Fisica Aplicada I, E.T.S. Ingenieros, Alda. Urquijo s/n, 48013, Bilbao, Spain

Saturn Section

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

Remote Planets Section

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

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ALPO Staff E-mail Directory

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

Comets Section

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

Meteors Section

- Coordinator; Robert D. Lunsford, 161 Vance Street, Chula Vista, CA 91910
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Meteorites Section

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

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- Lunar: *The Lunar Observer*, official newsletter of the ALPO Lunar Section, published monthly. Free at http://www.zone-vx.com/tlo.pdf or 70 cents per copy hard copy; send SASE with payment (check or money order) to: William Dembowski, Elton Moonshine Observatory, 219 Old Bedford Pike, Windber, PA 15963
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- **Minor Planets (Derald D. Nye):** *The Minor Planet Bulletin*. Published quarterly; free at http://www.minorplanetobserver.com/mpb/default.htm or $14 per year via regular mail in the U.S., Mexico and Canada, $19 per year elsewhere (air mail only). Send check or money order payable to "Minor Planet Bulletin" to Derald D. Nye, 10385 East Observatory Dr., Corona de Tucson, AZ 8564I-2309.

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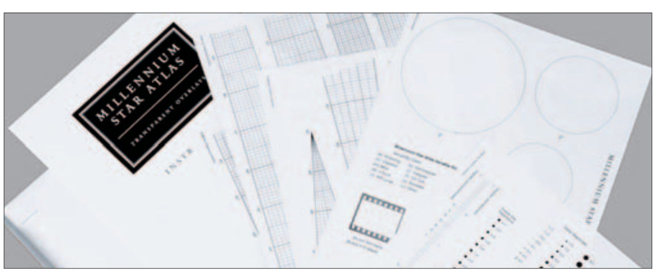

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