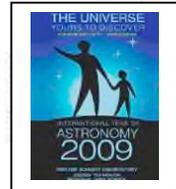




# First Light

The Newsletter of the Cape Cod Astronomical Society



November, 2009

Vol.20 No. 11

- **Next Monthly Meeting:** is Thursday, November 5th at the DY Library. Program notes below. If we are blessed with a clear night, and interest is sufficient, observing from the Schmidt will follow the meeting.
- The Last Fall Thursday Star Party is scheduled for 7:30pm, Thursday, October 29th, if not cancelled. (See the protocol for cancellations in the Star Party box on our main webpage.) After that, Star Parties open to all members and the public will resume on Thursdays in June, 2010.
- Contact [info@ccas.ws](mailto:info@ccas.ws) or Mike Hunter, Observatory Director, if you wish to set up a special Star Party for your group during the fall, winter, or spring months. MEMBERS, particularly newly joined MEMBERS: we would like to provide you an opportunity to observe. if you would like to schedule an evening at the Schmidt, contact us and we will try to schedule something for you soon.
- **Feature Stories This Month:**
  - Measuring the “Goodness” or our Skies Here on the Cape. Please Participate!
  - Confirming/Precising the Focal Length of a Mirror
  - Alien Abduction!!!

## Bright New Stars:

We like to welcome new members to our Society in this section of First Light each month. If you are a new member and have not yet been so recognized, or have new information for us (background, astro equipment preferred, interests, etc.) on yourself or someone else, please let us know (email [info@ccas.ws](mailto:info@ccas.ws)).

Many thanks to contributors to this issue: Tom Leach, Mike Hunter, Werner Schmidt, Bernie Young, and for the first time, Gail Smith.

**PLEASE CONSIDER SUBMITTING AN ITEM OR ARTICLE FOR PUBLICATION IN FIRST LIGHT.**

If you are a regular contributor, thank you very much!

## CCAS Events

Thanks to Robert Brookhart for his most informative and entertaining overview of “steel detailing” in various NASA projects during his career presented at our meeting on October 1<sup>st</sup>. Robert first provided us with an overview of steel fabrication and engineering techniques. Employed for many years with Kaiser Steel Fabricating in California, Robert was responsible for design work for many aspects of such things as towers and silos for Atlas missiles and the Saturn rocket.

One footnote to Robert’s talk was offered by former speaker Hugh Blair-Smith. Hugh was a programming contributor to some of the same space projects Robert discussed. Hugh related that in the 60’s and 70’s, insiders used to call NASA folks “Steely-eyed Missile Men”; so the steel engineers must have been “Missile-eyed Steely Men.”

Many thanks to Tom Leach, Program Chairman, and those persons who have agreed to speak, for the following outstanding programs for the upcoming months:

At our meeting on November 5th, Ryan Mann will talk about Dendrochronology, the study of annual growth rings in trees. Much like ice cores, carbon-14 dating and sediment cores, the layering system in trees can unlock clues into what is going on and what has happened in the past depending on environmental conditions. During the winter of 2008, Mann performed analyses on several core samples in an attempt to correlate data on weather patterns with spacing of annual rings in cedar trees found in Waquoit Bay.

Ryan Mann is a graduate of UMASS-Amherst and is currently Outreach & Stewardship Coordinator for the Harwich Conservation Trust. The Trust is a non-profit land trust organization founded in 1988 by citizens concerned with the rapid pace of development threatening the fragile natural resources of Harwich. The Trust permanently protects natural areas by receiving land donations, holding conservation restrictions on properties, and purchasing land

throughout Harwich. The Trust is not affiliated with town government.

At our meeting on December 3rd, Dr. Albur Rosenberg will give us a presentation on Atmospheric Optical Effects. Rainbows, mirages, auroras, the twinkling of stars, and even the blue color of the sky are all considered atmospheric optical effects. These visual events in the sky occur when light bounces off or is bent by solid particles, liquids droplets, and other materials present in the atmosphere.

Dr. Rosenberg, has a BA from Harvard, MS from the University of Florida, and PhD from Penn. Over the years, he has taught in many areas of the physical sciences at RPI, Penn and UMASS. He even taught "Astronomy 101" at the University of Alabama one year because "all the astronomy faculty members were off at observatories!"

Members, **PLEASE** consider participating in the effort to recruit speakers to present programs in astronomy and related sciences. Please send any ideas or contact information to Tom Leach, our President and Program Chairman. For sure he will follow up.

Or, even better, volunteer to give a talk yourself!

The minutes of our September meeting prepared by Charlie Burke, our Secretary, are on our website; click on on the "Minutes" button at [www.ccas.ws](http://www.ccas.ws) or go to <http://www.ccas.ws/minutes/ccasminutes100109.pdf>

## **Executive Corner**

The Executive Board exchanges ideas by email and phone on a continuous basis and now and then formally convenes by conference call. Anyone wishing to offer an item to the agenda, please contact Tom, Paul, Peter or Charlie.

### **All Members please update your dues!**

We are making progress: 5 more members sent in their checks in October. If you forgot again, please send this month; please bring to a meeting or mail directly to CCAS at PO Box 297 Harwich Port MA 02646. Thank you. .

## **From the Dome**

CCAS's participation in the worldwide celebration of "**Galilean Nights**" on Saturday, October 24, was planned to feature a Star Party at the Dome preceded by a special demo and discussion session on observing equipment out on the lawn. What happened was this: a monsoon and a fizzle.

Five observatory staff members enjoyed the company of three member guests (two of whom had never been inside the Dome) from 5:40 until 7:00 pm. Thanks to all who came out. We must love our hobby!

The 2009 "summer/fall" series of weekly star parties ended on October 29. The series was extended into September and October because of the extremely high number of weather cancellations during June and July. Let's all hope for clear skies for the start of the 2010 series on the first Thursday in June.

The Harwich Elementary School astronomy club had a very successful star party on October 20. Approximately thirty (it's hard to count the fast moving young'uns in the dark) club members, parents, and friends enjoyed the night skies, especially Jupiter. Society member Larry Brookhart, the Harwich group's faculty advisor, scheduled the party by waiting for a clear weather forecast and then picking the date. The attendees and observatory staff were able to respond on a one day notice.

The observatory staff has been working on establishing protocols and procedures for "Standard use/setups" for each of The Schmidt's several scopes.

For example, the Standard use/setup for the 16" has been set as visual with a 2" TeleVue eyepiece (usually 20mm) and a 6 x 30 finder scope. A motorized focuser is also mounted but only for use by trained, experienced observers. If someone wanted to use a different setup, such as mounting a CCD camera on the scope, they must 1) receive permission from the Observatory Director and 2) return the scope to the Standard setup after each observing session.

From time to time, special permission may be granted to leave a complex Nonstandard setup in place over two or more observing sessions.

By establishing Standard use/setups for each scope, and protocols for requesting Nonstandard setups and their takedowns, observatory staff and Society members are better assured of having each scope ready for "Standard" use when they arrive at The Schmidt.

The Observatory Staff has agreed to meet on specific Thursday evenings once a month from now until June.

...Mike Hunter, Director of the Observatory

**As always, "Private" group or individual observing sessions at the Werner Schmidt Observatory may be scheduled by contacting observatory Director Mike Hunter at [mamhunter@yahoo.com](mailto:mamhunter@yahoo.com) or sending an email to [info@ccas.ws](mailto:info@ccas.ws)**

**Our Society exists to promote observing!  
Promote this objective by asking for time in the  
Dome!**

**November Observing:**

**Foundation News...**

Thanks to Werner Schmidt for this update on work to complete planning for and shakedown of the proposed imaging system involving our 4” Televue, a Losmandy equatorial mount, a concrete pad with steel foot plates outside the Dome building, and, eventually and finally, installation and shakedown of our CCD imaging equipment:

The installation of the imaging equipment is continuing. The 30 square foot concrete pad was poured on September 28 and seems to be curing properly. As conventional Portland Cement concrete does not reach its maximum compressive strength until about one year, and 50% strength after about one month, we decided not to attach any steel support plates before the one month aging period. We have chosen 1/4 " stainless steel 304, each support piece being 4x12 inches, to be attached with stainless steel screws held in rawl plugs. The use of 4 x 12 inch plates will provide for adjusting the scope height about 3 inches, as needed by the Losmandy-wheely bar installation. You may recall that the Losmandy tripod legs are attached to the mount at a fixed angle, so that any height adjustment of the telescope legs results in a change in the spread of the legs. The use of 4x12 inch steel plates will let us keep the legs on the steel plates at all height levels .

Due to the unusual software of the Losmandy mount, it is mandatory that we learn how to use the mount in visual mode before adding the complication of the CCD camera. Thus our timetable for full implementation of the astro imaging capability is unpredictable at this time.

The next step will be the determination of the best location of the Losmandy on the concrete pad. It is essential that we block the school lights as much as possible and at the same time know how to achieve precise polar alignment .

Our target is to have excellent tracking over a 2 to 3 hour exposure time with the help of a guide star. We do have a polar alignment attachment and a GPS unit to help us in this endeavor. One pleasant thought: if we err in the location of the steel support pieces, we can easily re-place them.

When the pad is ready, we will begin working outside with the new assembly which eventually will be controlled and monitored from inside the Observatory.

**CCAS has both 8” and 14” Dobsonian telescopes for loan to members. Currently, Tom Leach is using the 14” for outreach in Harwich. If you wish to borrow one of these ‘scopes, contact [info@ccas.ws](mailto:info@ccas.ws)**

**Mooncusser’s Almanac and Monthly Alert<sup>1</sup>**

By Peter Kurtz

**NOVEMBER, 2009**

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<b>Object</b>	<b>Nov 1 (EST)</b>	<b>Nov 15 (EST)</b>	<b>Nov 30 (EST)</b>
<b>Sun</b>	R 06:13 S: 16:35	06:30 16:20	06:47 16:11
<b>Moon</b>	R: 15:35 S: 05:29	05:43 15:15	14:41 05:30
<b>Mercury (evening)</b>	R: 06:01 S: 16:31	07:05 16:34	08:04 16:53
<b>Venus (predawn)</b>	R: 04:42 S: 15:57	05:17 15:45	05:55 15:40
<b>Mars (evening)</b>	R: 22:18 S: 12:56	21:50 12:19	21:12 11:34
<b>Jupiter (evening)</b>	R: 13:15 S: 23:20	12:23 22:32	11:28 21:42
<b>Saturn (predawn)</b>	R: 02:50 S: 15:09	02:02 14:18	01:09 13:22
<b>Uranus (evening)</b>	R: 14:40 S: 02:22	13:44 01:26	12:45 00:26
<b>Neptune (evening)</b>	R: 13:27 S: 23:52	12:32 22:57	11:34 21:59
<b>Pluto (early eve)</b>	R: 10:05 S: 19:57	09:11 19:03	08:14 18:06

*Now is the best time or year for leisurely early evening observing: it isn’t hot; it isn’t cold; and, with the **end of Daylight Savings Time** early on Sunday, November 1, the sun sets well before 5pm! Get out early NOW and take in **Jupiter** and the antics of its moons before the season for the giant planet ends as it moves closer and closer to the sun.*

In fact, on the 23<sup>rd</sup> of this month, if you have a good telescope or even reasonable binoculars, you can find and look at **Jupiter in the afternoon**. At 5pm that afternoon, Jupiter lies only 4° south of the first quarter moon. Use the moon as a “guide star” to find Jupiter well before it gets dark.

**Neptune**, magnitude 7.9, very near Jupiter, and **Uranus**, magnitude 6, a couple of hours east, are special telescope targets in the evening again this month. If you don’t have a GoTo scope, excellent finder strategies for both can be found on p 45 of the November [Astronomy Magazine](#).

More on the planets and Jupiter’s moons later.

November marks again the arrival of debris from

55P/Tempel-Tuttle. The **Leonid meteor shower** should peak between 1:30am and sunrise (6:36am EST) on November 17<sup>th</sup>. Look to the east. If you don't want to go out at 1:30, at least try at 5am, a time many folks rise for a normal day. Absence of moonlight (moon is new) make conditions excellent. In some years the Leonids are very spectacular: possibly 20 or more meteors per hour; maybe this will be one of those years. Hint: you can see meteors from some showers for several days before or after peak; not so the Leonids; try to observe the morning of the 17<sup>th</sup>.

A note or two on NASA's "great LCROSS moon impact event" promised for October 9<sup>th</sup> and treated in some detail in this space in last month's First Light:

Based on the promise of an opportunity to see a rocket crash into the moon and create a plume of ejecta on live TV from NASA, many of us carved out time in front of our TV sets that morning.

Well, on NASA TV, at least on your editor's computer and snippets made available live on morning news shows, the event, as a public spectacle, was a dud.



NASA TV picture of Target Crater just seconds before (and also after!) Centaur rocket impact.

NASA's Lunar CRater Observation and Sensing Satellite (LCROSS) and its rocket did indeed impact the Moon's crater Cabeus, near the south pole, early Friday morning to provide data which might determine if the permanently shadowed crater might be hiding water ice.

According to a report by NASA reported recently on Astronomy Magazine online, at 7:31 A.M. EDT, the Centaur upper stage rocket did slam into the Moon at some 5,600 mph (9,000 km/h), excavating a new hole in the crater. About 5 minutes later, the LCROSS satellite itself smashed into the Moon, after flying through an expected cloud of debris kicked up by the first impact.

So NASA achieved its scientific objective. But the images from LCROSS which NASA broadcast failed to show a visible plume, even though visible light is just one of the

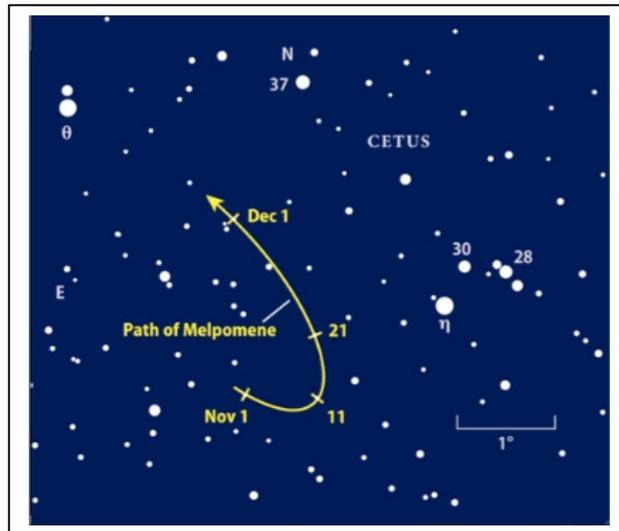
many types of data the satellite collected.

So science was accomplished. At a press conference following the broadcast, NASA officials downplayed the unseen debris plume, instead celebrating and looking forward to analyzing the high-quality spectroscopic data LCROSS did capture and return before its demise.

Many people were underwhelmed; not a good result for NASA. In the view of this editor, the problem is not that the plume wasn't visible; rather, helped a lot by the media, NASA made a big public relations mistake with all of the pre-event hype that promised an entertaining public spectacle. One hopes useful science will come from the analysis of the data. Check now and then with <http://lcross.arc.nasa.gov/> to find out.

### An Asteroid, not a Tragedy:

"Whether you see Cetus as a sea monster or a whale, it seems appropriate that an asteroid named for the Greek muse of tragedy now runs among the stars of this ravenous beast." (quoted from the article in reference 5.) The magnitude 8.6 asteroid Melpomene (pronounced "Mel POMeh nee") moves during November and December during the mid-evening hours when it lies about a third of the way up in the southeastern sky below Pegasus.



Take a look for Melpomene now; after December, it will be seven years until it shows as bright as it is this season. See the finder chart; the key stars are θ-ceti at top left and η-ceti a bit to the right of the shown asteroid path.

This season, Melpomene appears brighter than all but a few of the nearby background stars. Melpomene spans 88 miles and rotates on its axis once every 11.6 hours. See also reference 6 for more information.

### More on the Planets and Moons of Jupiter:

**Mercury** is in the sun as November begins and begins to be separated enough for naked eye viewing at dusk late in the month.

**Venus**, getting closer and closer to the sun, and **Saturn** remain early morning targets.

As promised last month, **Mars** continues to “star” in the solar system sky in November and will culminate at its largest at its opposition date (earth-sun-Mars angle of 0°) January 29, 2010. On that date it will rise at 4:37pm and show magnitude -1.3, apparent diameter 14”, fully twice as big as at the beginning of October. We also promised Mars passing through the Beehive, M44 in late October. This culminates during the first two nights of November.

The November issues of both Astronomy Magazine and Sky and Telescope have charts showing the hour by hour positions of **Jupiter’s Galilean moons** (pages 42 and 47, respectively) during November, and S&T also has a nice chart of when the moons transit Jupiter, hide behind Jupiter, or cast shadows. Check out the details for a shadow transit on the night of Nov 20-21 and a double disappearance behind the planet Nov 21-22. Details available on request.

Finally, we don’t normally highlight a full moon occulting stars but when the stars in question are as robust as the members of the Pleiades asterism, M45, special mention is warranted. On November 3, a nearly full moon rises in the east with the asterism and at 7:30pm EST is beginning to graze the stars on the south side. With binoculars or better, you should be able to observe the moon covering a line of 7<sup>th</sup> magnitude stars and, for observers in North America, you should see it occult the star Atlas, magnitude 3.6.

Check with the International Occultation Timing Association’s website, [www.lunar-occultations.com](http://www.lunar-occultations.com) for more details. (Astronomy Magazine, November, p. 47.)

### Moon Phases, November, 2009

<b>Full Moon</b>	Monday, Nov. 2 <sup>nd</sup> at 2:14pm EST
<b>Last QTR</b>	Monday, Nov 9 <sup>th</sup> at 10:56am EST
<b>New Moon</b>	Monday, Nov 16 <sup>th</sup> at 2:14pm EST
<b>First QTR</b>	Tuesday, Nov 24 <sup>th</sup> at 4:39pm EST

Anyone having an interest in monthly Libration and Declination Tables for the Moon<sup>2</sup> or Dates and Times for the Minima of Algol<sup>1,3</sup> during this month please contact your editor and the information or sources will be provided.

**A PORTION OF THIS PAGE IS  
INTENTIONALLY LEFT  
BLANK TO REMIND ALL  
MEMBERS THAT THERE IS  
ALWAYS PLENTY OF ROOM  
IN FIRST LIGHT FOR YOUR  
CONTRIBUTIONS.**

## Feature Articles:

### Measuring the “Goodness” or our Skies Here on the Cape. Please Participate!

This is an update to an email sent out last month.

Please to go out at night, between now and the end of December, let your eyes become dark adapted, look at the sky at the constellation Cygnus, the northern cross, and make an estimate of how good a sky it is at the time of your observation. Can you see stars to magnitude 2? to 3? to 5? to 7? Cygnus is high in the evening sky right now and will stay accessible as it moves farther to the west at least until the end of December. All you need do is look, decide which of several star patterns in Cygnus outlined on a one page reference chart you can see, and report on the dimmest pattern you can see. Do it once or many times!

Please go to [http://www.windows.ucar.edu/citizen\\_science/starcount/](http://www.windows.ucar.edu/citizen_science/starcount/) for a kit on how to make the observations and report your results. If you cannot access that website, please contact [info@ccas.ws](mailto:info@ccas.ws) and we will figure out a way to get you the materials you need.

When you access the website, you will find that the main effort around which that particular website was constructed was to end October 24.

But Mike Hunter, Director of our Observatory, has offered to plot the data from folks living on the Cape to generate a “Cape Cod Map” on all data he receives. So, if you make (an) observation(s), send the info to Mike ([mamhunter@yahoo.com](mailto:mamhunter@yahoo.com)) for all observations through end December. Include latitude and longitude (or at least town) for your observing site, date and time of observation, and the magnitude estimate for the sky you observed. Mike will put all reported data together and we will create a chart for the Cape. Maybe we can publish the chart in a future edition of First Light. Such a chart will snapshot where good skies have been experienced on the Cape in a way that may help us find “dark skies” when we need them.

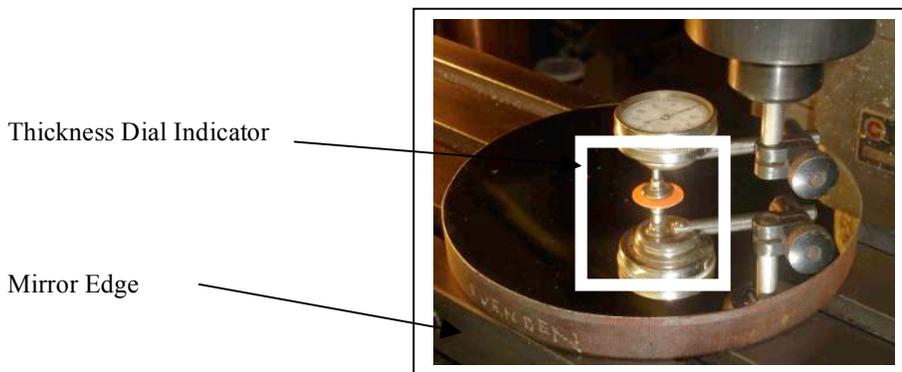
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## Confirming/precising the Focal Length of a Mirror

By Bernie Young

Bernie has been retuning a 6” Dobsonian telescope and thought members might be interested in the technique he used to newly measure key thicknesses at the mirror surface which, with the mirror diameter, allow calculation of the mirror’s focal length. Your editor will ask Bernie to do this measurement on the 13” mirror of a telescope he is refurbishing. ... Editor

I wanted to make some measurements on the recently re-aluminized mirror from the Evenden telescope I’m restoring. I put a dial indicator, accurate to 0.001”, in my milling machine and measured the thickness at the edges (0.672”) and the thickness in the center (0.622”) of the mirror. The nominal diameter of the mirror, D, is 6”. The difference between the thickness at the edge and the center, 0.050, is called the “sagitta” for a mirror: how deep one must grind the center to achieve a certain focal length.



Sagitta determines the Radius of Curvature which is twice the focal length:  $R=2F$ . My guess is that this mirror was designed to have a nice round number sagitta: (0.050).

Since

$$F \text{ (focal length)} = D(\text{diameter})^2 / 16 * s \text{ (sagitta)},$$

the focal length of our mirror is  $36/(0.8) = 45$ ”

Since the diameter is 6”, the f/ratio for this mirror, F/D, is 7.5

It's nice to have the thickness in the center, so you can achieve the focal length this way and avoid any possible contact with the optical surface during any attempt to measure the focal length by actually focusing light.

The blank for the mirror was actually a little oversize...I think this is common for blank disks.

When I was done, I used the dial indicator to set a sticker in the center of the mirror. That's when the photo was taken. One can lower the sticker (with a touch of glue on the bottom side) very nicely onto the center using the dial indicator attached to the machine.

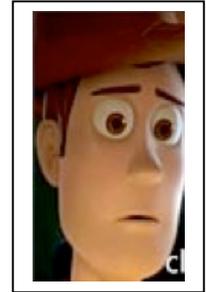
# Alien Abduction!!

... by Gail Smith

Many CCAS members know that beginning October 9<sup>th</sup>, the lower shutter door at the Dome was observed to be damaged and not operating properly. Until now, now no one knew what had happened to the shutter door.



This reporter has learned what happened. It turns out that our First Light editor was abducted by aliens late Thursday evening, October 8<sup>th</sup>, at a Star Party in full view of many CCAS members and guests. Apparently, he was tele-transported to a hovering craft 30 feet above the Schmidt Observatory in South Yarmouth, Mass. Mike Hunter, Observatory Director, was an eyewitness to the event. He was so unnerved that they had to show him dozens of Hubble photos to calm him down. After “chillin’



for a while, Mike was able to tell reporters that our editor had been in the observatory dome at the time of the abduction. He was “sucked out” in an instant. His foot caught the dome shutter, damaging it on the way out.

The abductors had made serious demands. Within hours after our editor disappeared, the following demands were tendered by the abductors :

- 5 bottles Aqua Velva
- All episodes of “The Twilight Zone” and “I Love Lucy” on DVD
- Face to face meeting with Spock
- 6 Red Sox season tickets
- 15 large Dunkin Donuts coffee cooladas , extra cream, shot of mocha
- Britney Spears holiday album
- Instructions on how to “tweet”

If these demands are not met , the aliens have threatened to send the hostage back! Negotiations are underway....

If we ever see our editor again, the CCAS officers have determined that he should pay for repairs to the damage to the dome, which he caused by recklessly allowing his foot to drag during the abduction.

In other astro-news, the sun comes up, the sun goes down. The moon rises, the moon sets. Venus and Mars are all right tonight. but the cow jumped over the moon.

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Editor’s Note: I’m baack! How I left and came back will be reported in a future story.

A mechanic from the D-Y staff has repaired the shutter door and it is operating correctly now.

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## Coming Next Month:

- In a month or so, Neptune will pass out of our night sky. Did you know when Galileo was discovering key things about the sky in 1609-10, he missed Neptune? A good story. We’ll vist it next month
- January 2010 marks the beginning of the year in which Galileo published *Nuncius Sidereus* announcing his observations on the solar system, the moon, the moons of Jupiter, and other then new phenomena. Our December issue will celebrate his book and some interesting aspects of his observations on the moons of Jupiter.

## Cape Cod Astronomical Society

President	Tom Leach	508-237-9291
Vice President	Paul Cezanne	508-487-1456
Secretary	Charles Burke	508-394-9128
Treasurer	Peter Kurtz	508-255-0415
Observatory Director	Michael Hunter	508-385-9846
First Light Editor	Peter Kurtz	508-255-0415

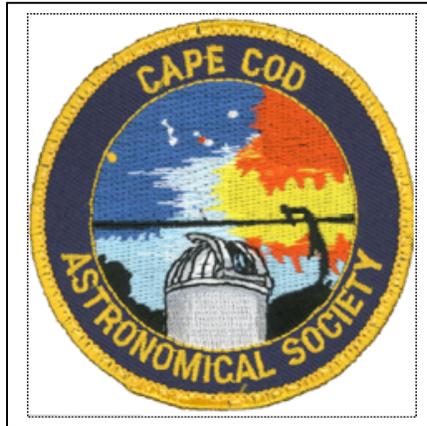
[info@CCAS.ws](mailto:info@CCAS.ws)

Mailing Address: PO Box 207 Harwich Port MA 02646

## Cape Cod Astronomical Foundation

Chairman	Werner Schmidt	508-362-9301
Vice Chairman	Michael Hunter	508-385-9846
Director R&D	Bill McDonough	508-771-0471
Secretary	Ed Swiniarski	508-896-5973
Treasurer	Pio Petrocchi	508-362-1213
Observatory Director	Michael Hunter	508-385-9846
Observatory		508-398-4765

The **Cape Cod Astronomical Society** meets at 7:30 pm on the first Thursday of every month in the library of the Dennis-Yarmouth Regional High School in Yarmouth, Massachusetts. Meetings are open to the public. Membership dues are \$30 for adults, \$15 for students in two year colleges and part year residents, and no charge for spouses or for students in K-12 schools.



### Reference Information:

- 1) Information for The Mooncussers Almanac and Monthly Observing Alerts was extracted from Sky Events, Astronomy Magazine Online (Astronomy.com), Stargazing.net's Planet Rise/Transit/Set calculator (<http://www.stargazing.net/mas/planet2.htm>), *Astronomy Magazine*, *Sky & Telescope Magazine*, *Sky and Telescope Skywatch 2007*, and other sources. The *Observer's Handbook, 2007 and 2008*, published by The Royal Astronomical Society of Canada is also an important reference, particularly for information on lunar libration and declination and the minima of Algol.
- 2) Information on how Libration and Declination Maxima and Minima can make visible parts of the moon normally hidden was reviewed in the December-January First Light. Quick recap: Max Long brings to view extra right side; Min Long, extra left side; Max Lat, extra north side; Min Lat, extra south side. Max Dec puts it high in our sky during its transit; Min Dec puts it low.
- 3) Algol is an eclipsing variable star in Perseus which has its brighter component eclipsed or covered by its companion once every 2.87 earth days. When the dimmer component is not eclipsing the brighter, Algol appears typically about magnitude 2.1; when eclipsed, magnitude 3.3 The minima usually lasts about two hours with two hours on either side to bring it back to mag 2.1. Good comparison stars are  $\gamma$ -Andromedae to Algol's west, mag 2.1, and  $\epsilon$ -Persei to its east, mag 2.9.
- 4) <http://www.astronomy.com/asy/default.aspx?c=a&id=8707>
- 5) <http://www.astronomy.com/asy/default.aspx?c=a&id=8640>
- 6) <http://www.rasnz.org.nz/MinorP/09Melpomene.htm>