CONSTELLATION

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Welcome to 2012

- by Gary Sprague

So is the world really going to end in 2012? If you believe the popular press, yes, the Mayan calendar clearly predicts the end of the "world." Unfortunately, if you listen to the scholars, the experts about the Maya culture and calendar, we might expect the end of a phase, the beginning of another. So now that you can relax about the world ending, let's see what lies ahead of us at BMAA.

Do you know what our mission is at BMAA? When Bernie and Ed asked me to consider running for president, one of the first things I did was check that out. If you look at the website, our purpose is to improve astronomical knowledge and observational skills and to promote public interest in astronomy.

So, to promote public interest, George has star watches planned for 2012 and we have a dedicated group within the club who support our outreach in this area. If you have not attended one of our star watches, you need to try one. You don't even have to bring your telescope. We can always use members who are willing to help give directions and answer general questions. If you have one of the new iPads with the astronomy app, bring it out. They are great for answering questions. I'm going to try to convince Brad and Bernie to bring their video system out to a star watch, to evaluate its utility for viewing by groups.

There may also be some changes in 2012. We're looking into possible alternate locations for our general meetings that might be more accessible. Ed plotted member home zip codes which suggest a location in Warrington, Horsham or the Warminster area might be pretty much central.

So, we also have some (hopefully) interesting sessions planned for our general meetings in 2012. We don't currently have a public star party in the works, in 2012, our goal is to grow our club this year and give more members an opportunity to get involved as each feels able and appropriate.

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Some interesting astronomy history:

The January issue of Astronomy had a very interesting article about Milton Humason and his contributions in our understanding of the expanding universe. I mention this as being historically important in January because a meeting was held in Pasadena (the offices for the Mount Wilson Observatory) in January, 1931. It was attended by Milton Humason, Edwin Hubble, Albert Einstein, along with other prominent astronomers of their time.

Humason was such an interesting character because he only had an 8th grade education and made a huge contribution to astronomy. He was responsible for some of the original spectrographic observations with the 100 inch Mount Wilson telescope that detected the "red shift" in wavelengths of galaxies, demonstrating their movement away from us; our expanding universe.

The article describes the effort that went into some of those original observations. Exposures lasted for days, with manually checking the guiding of the huge telescope and the dome of the observatory. Furthermore, Humason teamed up with Hubble who was unlike Humason in so many ways, except for his dedication.

If you enjoy reading about astronomy history and the human side of famous astronomers, I encourage you to read the article on pages 52 - 57 of the January issue of Astronomy.

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- *Gary Sprague is the current BMAA President [ed]* –

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Gary Sprague, President — **Bernie Kosher, Vice President**
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Interesting Alignment At Jupiter

- by Bill Smith

Astrophotography is quite amazing these days. Significant results can be obtained with very modest equipment. I particularly like to photograph the planets using a $60 webcam and a small 3½ inch telescope.

On the evening of November 20, 2009 I took a series of pictures of Jupiter between 6:26 and 7:07pm. The seeing was mediocre but by taking 2,000 to 3,000 frames for each image then stacking the best thousand or so, I was able to see quite a bit of detail on the planet surface. Shown below are five of these images spaced at about ten minute intervals. North is up and East is to the right.

As I stacked and processed the first image I was pleased to see that I had also managed to capture what looked liked shadows from two of Jupiter's moons. I have seen two shadows before but not very often. As I processed the other 4 images the two shadows seamed to merge and then split apart. This was something new to me. Note that the shadows are very close to Jupiter's equator.

I could also see that one of the Galilean moons was just moving off the eastern limb of the planet. I guessed that this moon was responsible for one of the shadows. I searched the images carefully hoping to find a 2nd moon that might be casting the 2nd shadow but could only find the one moon. This seemed to me to be an unusual alignment requiring that both moons would be in the same orbital plane. Since the shadows were traveling along Jupiter's equator this plane would have to bisect Jupiter's equator and the sun. From Jupiter's surface it would look like a double total solar eclipse. The Sun was being eclipsed by two moons at the same time. Now that would be something worth seeing!

Recently I had the good fortune to acquire an iPad with the Sky Safari software. Recalling the unusual shadow sequence from 2009 I decided to replay the events using the iPad. The Sky Safari software is amazing. It allowed me to locate Jupiter on Nov 20, 2009 and simulate the movement of the planet and moons minute by minute. I was able to enlarge the picture so I could see exactly what was happening.

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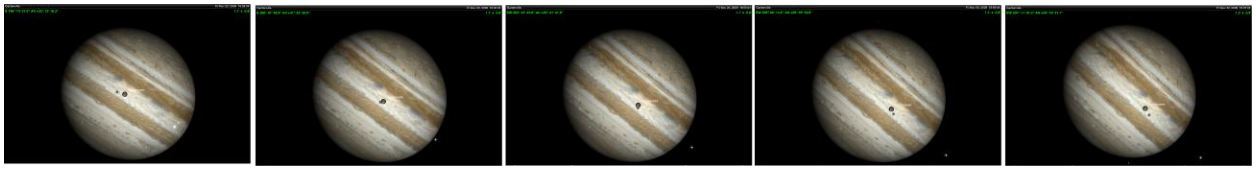
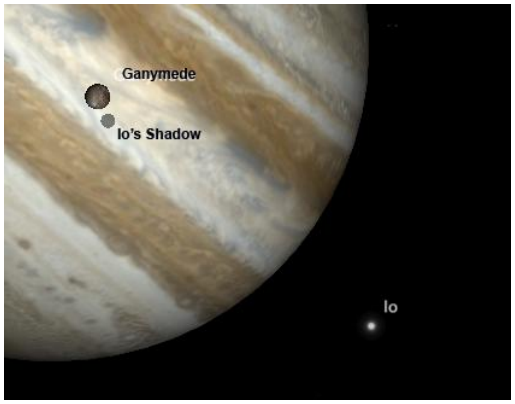
Below is a sequence of pictures taken from the Sky Safari software set to the same date and time as the sequence I photographed in November 2009.



18:26 18:40 18:50 18:59 19:07

As you can see both sets of pictures are in close agreement. The two shadows are merging then splitting apart along Jupiter's equator and a moon is moving off the eastern limb of the planet. According to Sky Safari the moon is Io and one of the shadows does belong to Io. Looking closer I found out that the other shadow is actually not a shadow but the moon Ganymede. Here is a close-up of the 4th picture from Sky Safari so you can see the relationship of the two moons, Io's shadow and the planet.



My initial assessment from 2009 was incorrect but I believe this is even a more unusual alignment. We now have Io casting a shadow on Jupiter's equator and the moon Ganymede appearing from Earth to be lined up with that shadow. This would require that the Sun, Earth, Ganymede and Io would all have to be in the same plane as Jupiter's equator. If you were an astronaut at just the right point on Jupiter's surface you would have a real treat at approximately 18:40 Eastern time. You would see a total solar eclipse by Io and a simultaneous eclipse of Earth by Ganymede.

The camera I used for the 2009 pictures was an unmodified Phillips SPC900nc webcam fitted to the eyepiece holder of my telescope. The scope was a fork mounted 89mm maksutov operating at f/28 with a focal length of about 2,500mm. The scope was mounted on a homemade wooden wedge and tripod and was driven with a synchronous AC motor. No guiding was used but I did do a careful polar alignment. The video captures were typically about 2 minutes and I used the freeware program Registax to process the images.

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- BMAA member Bill Smith submitted this article for the CONSTELLATION [ed] -

Observer's Tips

"A scope with an optics problem"

- by Bernie Kosher

As we enter 2012, I haven't written a column for a while and would like to first ask that anyone with a specific or general question which could be covered in these columns let me know. It doesn't matter if the subject is not familiar to me, as I will refer it to one of our many knowledgeable members. Don't be surprised if I come back with a question.

I recently refigured a 13.3" f4.5 mirror from an old Coulter scope owned by Ed Radomski. He had purchased a new Orion 12" and this one was just sitting around. The mirror required considerable refinishing, but that's another story.

The mirror was refigured by standard ATM methods on a pitch lap using the Foucault test to verify the condition and surface errors. After a bit of doing the mirror tested to about $1/6^{th}$ wave total peak to valley error at the wavefront. This translates to about $1/20^{th}$ on the rating system used by some vendors and better still if using some of the questionable systems of others.

Anyhow, if properly mounted and collimated it should have performed well.
A secondary mirror (AKA diagonal) of 2.8" minor axis was purchased, as this size was about the minimum to give decent illumination over a wide field without diffraction unduly affecting the image. One cannot have everything in one scope, so this one is primarily a light bucket with a good figure.

After receiving the mirror from the coating service I eagerly set up for first light. The site I used is in south Jersey near Barnegat and is decent for dark skies and wonderful for having a low horizon. As it was spring the Virgo-Coma-Leo region, the "Realm of the Nebula", was still high up. Needless to say I was soon lost identifying faint fuzzies which were beyond the atlas I was using. But that, also, is another story. Later, the Milky Way toward Sagittarius and Scorpius was well up in the sky.

I was tickled by the brightness of the target objects and the depths I could reach with it. Bear in mind that I have never owned a scope over 8" so my experience with larger ones is strictly borrowed observing and at star parties.

After bouncing from these bright targets I tried some small planetaries. Aha! Not happy. Found it hard to focus to a point (actually a diffraction disk, but that's another story-see above) and difficult to distinguish a three arcsecond planetary from a star. "What the hey?" I exclaimed in righteous indignation (I've always wanted to throw that expression into a column), "Why am I getting poor images?"

This brings us to the point of this story, namely tracking down problems in the scope. In some cases this may prove useful to anyone having difficulties with their instruments' performance, but in other cases may mean the main mirror is not up to snuff, in which case you are at the mercy of the manufacturer and the exchange program.

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First I checked the out of focus diffraction pattern to see if that would give a clue. No real help, as the pattern was ovalled and at high power focus the image looked a bit 'fan shaped'. This could be from a number of sources so further testing was required.

The mirror was checked for pinching, which normally would give a triangular or three'd image of some sort but this was an easy thing to check so I did it anyway. No problem found. As mentioned, the collimation was good but I rechecked it anyway. Now we get to the more difficult tests. The secondary was checked for pinching. That was OK.

So I took the secondary out, removed it from it's mount and tested it using a spherical mirror. If you are interested in how and why I did it this way please let me know. It is an optical test and although not particularly difficult is not something most people would be interested in or have the equipment to do.

The secondary was found to be out of flat by a considerable amount. Oh dear. I tried the scope with the original Coulter supplied secondary and things were even worse. Turns out the secondary mirror was mounted to a steel plate with a hard and unyielding cement. Needless to say, this is not good. Any change of temperature would stress the mirror, as would the change of dimension as the adhesive dried and aged. This was tested, after stripping the coating (the coating was removed as the contrast of the fringes is far better if the two surfaces are about equal in reflection), by Newton's fringes, an interference fringe test which will be demonstrated at an upcoming meeting. It was found to be warped to a considerable degree.

The mirror was removed from the plate and re-tested after scraping the adhesive from the back. It was much improved. Oddly, after several months just sitting around it was found to have improved even more. Perhaps the glass was so badly strained it required some sitting time to return to its original shape. Or perhaps the strain is permanent and the slightest change in temperature or pressure will affect it.

Anyhow, it appears a better one is going to be needed. Although I have made mirrors and lenses, a flat of this size is not expensive and would be very difficult to make, not so much optically as mechanically as it would involve cutting a glass ellipse with sloped sides and grinding and figuring same using a 'surround' of glass and then having it coated. The small amount of money saved would not at all justify the time. I will refigure this one someday, though.

The above is how I solved the mystery of the poor performance. The various tests used will be explained at a future meeting, with demos of both the Foucault test and Newton's fringes in the interference test.

I will keep you posted on the performance of the scope when all is complete.
Thanks for your time, and will see you soon.
Achmet

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- *BMAA VP Bernie Kosher has contributed 'Observer's Tips' to the CONSTELLATION for many years, and occasionally some of his older columns are reprinted here [-ed] -*

Dawn Takes a Closer Look

- by Dr Marc Rayman

Dawn is the first space mission with an itinerary that includes orbiting two separate solar system destinations. It is also the only spacecraft ever to orbit an object in the main asteroid belt between Mars and Jupiter. The spacecraft accomplishes this feat using ion propulsion, a technology first proven in space on the highly successful Deep Space 1 mission, part of NASA's New Millennium program.

Launched in September 2007, Dawn arrived at protoplanet Vesta in July 2011. It will orbit and study Vesta until July 2012, when it will leave orbit for dwarf planet Ceres, also in the asteroid belt.

Dawn can maneuver to the orbit best suited for conducting each of its scientific observations. After months mapping this alien world from higher altitudes, Dawn spiraled closer to Vesta to attain a low altitude orbit, the better to study Vesta's composition and map its complicated gravity field.

Changing and refining Dawn's orbit of this massive, irregular, heterogeneous body is one of the most complicated parts of the mission. In addition, to meet all the scientific objectives, the orientation of this orbit needs to change.

These differing orientations are a crucial element of the strategy for gathering the most scientifically valuable data on Vesta. It generally requires a great deal of maneuvering to change the plane of a spacecraft's orbit. The ion propulsion system allows the probe to fly from one orbit to another without the penalty of carrying a massive supply of propellant. Indeed, one of the reasons that traveling from Earth to Vesta (and later Ceres) requires ion propulsion is the challenge of tilting the orbit around the sun.

Although the ion propulsion system accomplishes the majority of the orbit change, Dawn's navigators are enlisting Vesta itself. Some of the ion thrusting was designed in part to put the spacecraft in certain locations from which Vesta would twist its orbit toward the target angle for the low-altitude orbit. As Dawn rotates and the world underneath it revolves, the spacecraft feels a changing pull. There is always a tug downward, but because of Vesta's heterogeneous interior structure, sometimes there is also a slight force to one side or another. With their knowledge of the gravity field, the mission team plotted a course that took advantage of these variations to get a free ride.

The flight plan is a complex affair of carefully timed thrusting and coasting. Very far from home, the spacecraft is making excellent progress in its expedition at a fascinating world that, until a few months ago, had never seen a probe from Earth.

Keep up with Dawn's progress by following the Chief Engineer's (yours truly's) journal at http://dawn.jpl.nasa.gov/mission/journal.asp. And check out the illustrated story in verse of "Professor Starr's Dream Trip: Or, how a little technology goes a long way," at http://spaceplace.nasa.gov/story-prof-starr.

This full view of the giant asteroid Vesta was taken by NASA's Dawn spacecraft, as part of a rotation characterization sequence on July 24, 2011, at a distance of 5,200 kilometers (3,200 miles).

Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

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- This article was provided courtesy of the Jet Propulsion Laboratory, California Institute of Technology, under a contract with National Aeronautics and Space Administration [-ed] -