SJAA EPHEMERIS

Through the Eyes of a Professional Observer
Lick Vulcan Camera Project

Peggy Bernard

Now that I have finally been working as a professional observer, I though I'd share some thoughts about my experiences.

The program I am working on is a feasibility study as part of the Kepler Program run by NASA Ames Research Center. My assignment is to operate the Vulcan Camera telescope at Lick Observatory's Crocker Dome. The goal is to detect planets around stars outside our solar system. The ground based effort, if successful could lead to the construction of a Sun-orbiting spacecraft specifically designed to detect planets around distant stars.

Our current star field is in Cygnus so we are essentially looking at the Cygnus arm of our own galaxy. Other star fields with similar characteristics have been examined and there are additional star fields that we have yet to explore. Our galaxy has been estimated to be about 5000 light years thick in the region of our sun so there are plenty of stars to look at! The star fields are determined and selected by our NASA Principle Investigator William Borucki and his image team members.

Basically, the theory behind detecting planets around other stars goes like this: If we assume Jupiter-sized planets orbiting sun-like stars, then there should be a 1% drop in brightness of the star as the planet transits across the face of the star. In actuality, in our own solar system, a Jupiter/sun transit does produce a measured 1% change in brightness so that's where the 1% value is derived from.

If we can continuously measure this brightness on a star outside our solar system and observe a drop in brightness with a duration of about 2 hours, we might be able to detect the 1% change in brightness. Unfortunately, the noise that we might experience in our measurement system might equal 1% thereby masking out our desired brightness change. So we solve this problem by reducing the noise. However, we can't change the signal. It is always the ratio of the planet's area to that of the star it orbits.

We improve the signal to noise ratio by using "Folded Time." "Folded time" is not something from *Star Trek*, but rather simply overlaying a particular star's image brightness multiple times, image after image, night after night. "Folded Time" or "Folding" multiple image sets, taken at different times, of the same star, over top one another has the effect of reducing the noise by the square root of the number of "folds." The more "folds," the greater the noise is reduced. However, the signal level stays the same because we must always divide by the number of folds. Actually, after processing the signal in this fashion,

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SJAA Activities Calendar

Jim Van Nuland

October

- **1** Houge Park star party. Sunset 6:50 p.m., 50% moon rises 0:04 am.
- **2** Star party Fremont Peak. Sunset 6:48 p.m., 39% moon rises 1:04 am.
- **9** Star party at Henry Coe, Fremont Peak. Sunset 6:37 p.m., 2% moon rises 8:12 am.
- **15** Houge Park star party. Sunset 6:30 p.m., 36% moon sets 10:55 p.m..
- **16** *Autumn Astronomy Day* — See story page 8.
- **23** General Meeting at Houge Park, 8 p.m.. Jane Houston, *Telescope and Mirror Making*.

October (Continued)

- **29** Houge Park star party. Sunset 6:12 p.m., 65% moon rise 10:57 p.m..
- **30** Star party Fremont Peak. Sunset 6:11 p.m., 54% moon rise 11:59 p.m..
- **31** End of Summer time. Set clocks back 1 hour, and apologize to your honest sundial.

November

- **6** Star parties at Henry Coe, Fremont Peak.
- **12** Houge Park star party.
- **20** General Meeting at Houge Park, 8 p.m. Dr. Ken Croswell speaks on *The Magnificent Universe*, a follow-on to Timothy Ferris' *Galaxies*.

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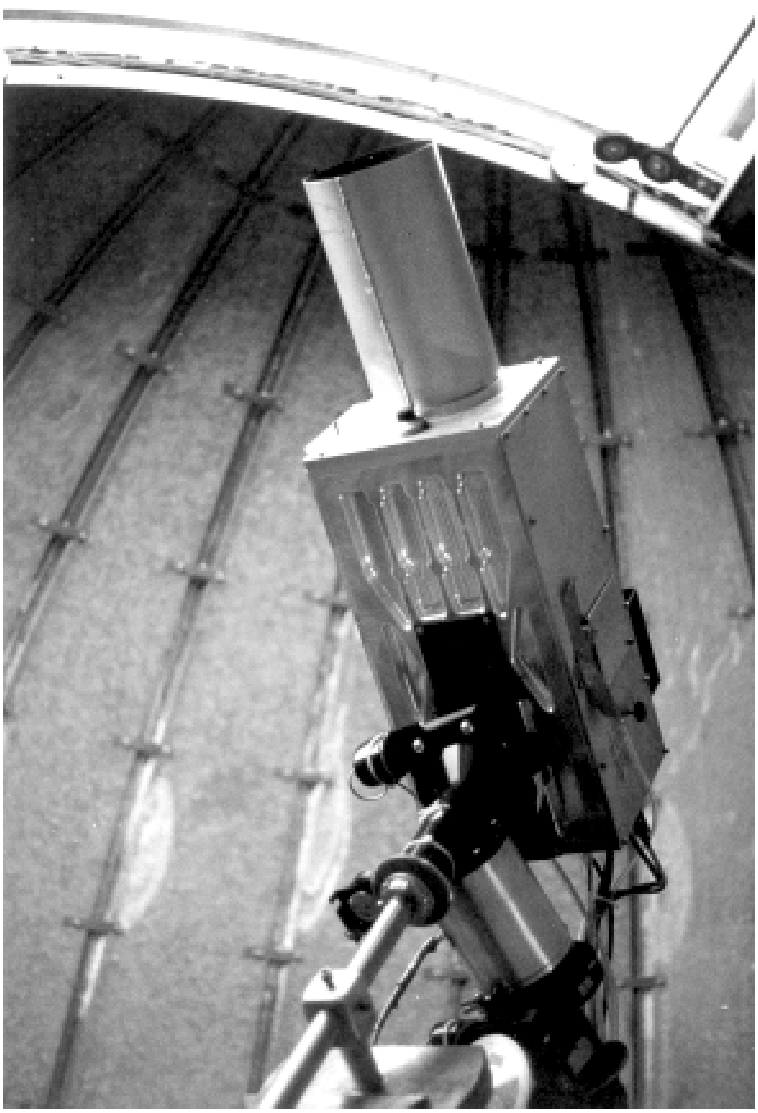
we are able to see very pronounced "notches" of objects transiting target stars.

Other characteristics of the planet can also be determined with this method. We accurately record the times of observations as our image and data computers are time synchronized to both WWVB and GPS. Knowing the precise time events occur allows the image team to also determine the orbit time of the planet around the star. The planet's size ratio and orbital period are obtained from the transit information.

If a star is too big, as with some O and B spectral type stars and with the giant and supergiant stars, the transit signal would be too small to detect — the transit of a Jupiter sized planet would generate a change in brightness considerably less than 1% and therefore would be lost in the noise.

The telescope itself is a small 4" f/3 cooled CCD camera capable of detecting transits of stars as dim as 12th magnitude. There is a second cooled CCD telescope mounted on the camera for auto guiding in both right ascension and declination.

CCD's are "Charged Coupled Devices." Simply put, they are a huge array of solid state, semiconductor "capacitor" cells (pixels). Each "cell" is sensitive to light and generates a small electric current when photons of light strike the cell surface. This current charges each of the pixels in proportion to the brightness of the image on the pixels. Each cell in the array is then electronically scanned for its charge. These charge values are then read out of the CCD array for use by the imaging computer to build an accurate image. The resulting image can then be displayed on the computer screen and also stored as image digital data on a CD-ROM for later analysis on other computers.



Vulcan Project CCD camera. Photo by the Author

The equipment controlling the telescope is quite sophisticated. Three computers are used for control, data collection, analysis, tracking, and CD-ROM generation. There is a fourth computer controller similar to Meade autostar hand held controller out in the dome used for reference and guide star locating capable of providing 8,388,608 steps, which results in 1.3 arcsecond resolution for operator pointing at the reference and guide stars.

After the telescope is setup and tracking the guide star, the bulk of the work involves controlling and monitoring everything using the computers.

Our galaxy is about 5000 light years thick ... so there are plenty of stars to look at!

Here is what my typical night of observing is like.

Arriving on site, I unlock the dome and power up the computer monitors. Then there is about an hour's work to do setup and calibration before imaging can begin.

The scope is uncovered and uncapped. It is then pointed at a white calibration screen inside the dome. The rest of the main image CCD, CCD coolant chiller equipment, and drive control electronics are then powered up following a power up sequence. A special translucent screen is installed in the front of the telescope in front of the shutter and lens. Dome and CCD chiller temperatures are recorded. The imaging CCD is kept at –26 degrees C whereas the tracking CCD is kept at –7 C. Another special filter inside the camera behind the shutter is then

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checked for condensation, and if any is present, I have to dry it out with a blower. The calibration light is turned on illuminating the calibration screen and the dome lights are turned out.

Then I'm ready to begin the CCD calibrations for the main CCD in the camera (no calibrations are run on the Guide Star CCD). The purpose of these calibrations is to quantify the *flat*, *bias*, and *dark* characteristics of the main CCD. After the first *flat* calibration runs, I reenter the dome to turn off the calibration lamp and remove the translucent *flat* calibration screen. The *bias* and *dark* calibrations are then run. All of the calibration data is recorded to disk files. Calibration sequences take about 45 minutes to complete. This is repeated again at the end of the observing session.

Here are some definitions:

bias – Bias is an offset that occurs when a pixel is read. Unfortunately, every pixel has a slightly different bias level. If it is not removed, it becomes a source of noise in the image. A bias frame is essentially a zero length exposure with the shutter closed. Measured bias values are then subtracted from the image. It is the first step in the image calibration, but is not done if a *dark* with the correct duration is available.

dark – CCD pixels produce a certain amount of dark current which accumulates in the pixel during exposure regardless of whether the pixel is illuminated. Dark current is produced by heat and that's one good reason to cool the CCD array. Dark current accumulates at different rates in each pixel during exposure. If not compensated for, this will add large amount of noise to the image. Dark current is measured with the shutter closed and is taken for the same time period of the image exposure frames. Once dark current of the CCD is measured, this data subtracted from the image resulting in huge image quality improvement. To reduce the effects of random noise, multiple dark frames are usually taken.

flat – CCD pixel sensitivity to light. This step follows the *dark* calibration step. Each pixel has a slightly different sensitivity to light and this adds a noise component know as *flat field error* to the image signal. Basically, the limiting magnitude of a CCD system is determined by the sky background and the flat field error. To obtain a flat field calibration, a bright light is turned on to illuminated a white card in front of the CCD telescope with the shutter open. Between the camera lens and the light source is a ¼ inch piece of white plastic sheet, which is used as a flat field screen. The flat calibration is used to improve images by dividing the flat frame data into the image frame data. This removes pixel-to-pixel sensitivity variations from the image.

My preference is to maintain my night vision, and ... enter the dome using my red flashlight

So *flat* calibration records the level of each CCD pixel with a uniformly "flat" brightness field applied across the surface of the CCD. Since each pixel is not uniform in the amount of current it produces for a given brightness, we simply measure and record the flat level of each pixel prior to imaging.

Bias calibration records the quiescent current operating point of each pixel. This is again not uniform for each pixel so we need to again measure and record the bias level of each pixel prior to imaging.

Since *flat*, *bias* and *dark* calibrations are taken at the beginning and end of each observing session the delta drift of the calibrations between the beginning and end of the observing session can be calculated and applied.

Once calibrations are complete, I reenter the dome, open the slit and rotate the dome to the target area of the sky. When it's dark, I make sure the dome lights are off and locate the reference star using a Telrad and a magnified finder. The tricky part is next. After telling the autostar hand held controller that I have found the reference star, I then need to move the telescope to the guide star coordinates. This sounds simple, but trying to hold the autostar hand held controller, read its dim display while moving a very heavy telescope, in the dark, isn't real easy. When I finally get it to about the right place, then I jog the telescope into precise position coordinates with the control joystick paddles.

Then I run back to the control room to see if I've got the guide star close enough for the autoguider to grab. If it's OK, then I close the control room door and begin the autoguide sequence. The auto guiding is done with a second CCD and MAXIM DL software. Essentially, the feedback loop for tracking the guide star is sample the guide star image in pixels, calculate how far the guide star is off the desired X and Y "centroid" target location in "error" pixels, move the telescope the corresponding amount of error pixels to eliminate the error, then resample the guide star image. This loop continues either until the guide star fades, the background gets too light (as in dawn at sunrise), or the operator purposely interrupts the process. When tracking properly, guiding is accurate to a few tenths of a pixel.

Once the telescope is auto guiding, then I begin the data set runs. Each of these is a 7-½ minute CCD exposure controlled by the imaging computer and "V for Windows" software. There is a 30-second computer image processing and storage overhead time, so the entire image cycle is really 8 minutes. Using "V" image display commands, I check the star images of the first data set on my data computer screen. If I see the correct

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star field, I program the data computer for multiple runs. At the end of each image run set, which can be from 8 to 160 minutes (I do a lot of 96 minute sets myself) depending on conditions, I reenter the dome and check the dome slit position as the dome is under manual control. I also record main imaging CCD and dome temperatures.

This process is repeated all night long until dawn. Between image sets, the shutter on the camera is closed via software control so the dome lights can be turned on during dome entry. However, my preference is to maintain my night vision, and to operate the control room monitors in "night vision" mode, then enter the dome using my red flashlight. That way I can easily see the star field, telescope, dome slit positions and can readily tell if everything is lined up. Not having turned on the dome lights, there is no risk of making an exposure set with the dome lights left on by mistake. The telescope is not touched during this entire process.

Things get real busy at the end of data sets. In addition to my dome duty, I need to make CD data disks. I begin this task after the next data set has been started. There is a sense of urgency to get the data disks completed because the imaging computer has been known to crash if it gets overloaded with data. Each image file is 32 megabytes, which may not seem like a lot but when you have 18 to 22 of these, that's a lot.

The CD ROM recordings are audited by displaying a few image sets to the screen by using a program called MIRA. MIRA allows us to view the CD *image*, *flat*, *bias*, and *dark* data. The image sets are all the same (and they should be!) and are loaded with thousands of stars. *Flats* appear simply as a white field. *Bias* and *darks* just look plain weird!

So what do we do with all this data? Well, the object is to detect Jupiter sized planets around stars. When the planet moves in front of the star, the brightness of the star dims. Our equipment and technique is looking for about a 1 to 2 percent change in brightness. Candidate targets are further examined by making spectroscopic measurements with large telescopes at several observatories including the Keck telescope in Hawaii.

Cookies, hot tea, and a radio playing good rock and roll make it rather pleasant.

Major differences between doing this work and a typical amateur astronomy night seem to be the restriction of a dome, looking at the same area of the sky all night, and looking at images on a computer screen and not through the eyepiece. Also, the environment can be extremely cold and VERY windy. All sorts of bugs seem to be attracted to the control room lights so sometimes I squash a few critters. Fortunately, being properly dressed and having a cozy control room with a heater helps with the wind and cold. Cookies, hot tea, and a radio playing good rock and roll make it rather pleasant. Of course there is the requirement of staying up and alert from dusk to dawn and lots of caffeine helps with that.

So there you have the Vulcan Program in a nutshell. So far we have found several interesting candidate stars in the Cygnus field. As we continue our search, I'm confident that we will find other excellent candidates. After all, there are "billions and billions of stars out there" so if even half of those stars were candidates, there should be millions and millions of planets.

The Crocker Dome at Mt. Hamilton's Lick Observatory. Photo by the Author

Above Glacier Point — Labor Day 1999

Jane Houston

Almond orchards and strawberry fields make way for the first signs of a changing terrain. Soft rounded mounds replace the ancient seabed we see today as the great Central Valley of California. Gentle contours offer but a glimpse of the granite wonder of the Sierra Nevada nearby.

DJ Smoky Silver drawls on 93.9 FM. The central valley radio station plays both kinds of music, country *and* western. We listen to the perfect road music on the perfect road, California state highway 120. We pass the table mountain, a lava filled remain of the ancient Stanislaus River. The black river mold snakes through the landscape to our right, then as we drive through a gashing roadcut the lava river continues on our left — a reminder of the turbulent geology of this part of California.

Candy-apple shaped oak trees dot the golden hills. Tombstone rocks jut up like jagged row crops. The sky is a hazy gray in the foothills of the Sierra Nevada range. What will transparency and seeing be for the weekend at our destination — Glacier Point at Yosemite National Park? Thousands of acres of California burn or smoulder nearby.

The summer weekends from the Fourth of July to Labor Day bring astronomy clubs throughout Northern California to this magical place. We join the millions of park visitors, gasping at the glacially carved granite which makes up walls of the Yosemite Valley. We wonder along with them at the valley view below Glacier Point. A lone hawk catches a ride and glides gracefully on a thermal, rising thousands of feet in seconds.

My club, the San Francisco Amateur Astronomers, drew Labor Day in the astronomy weekend lottery this year. The deal is an exchange for free park entrance and a free group campsite. All we have to do is provide a sunset talk overlooking Half Dome and offer the public an evening of stargazing at the 7200 foot elevation of Glacier Point, a vista of unsurpassed beauty. A real no-brainer! And it's real dark too! Solar scopes draw day hikers and nature explorers from every country of the world to explore a new place — a star — our sun. We show the sunspots in white light and prominences and other features through H-Alpha filters. French, German, Japanese are spoken. So is Australian. We listen to the many shades and hues of English. The wow factor transcends all languages.

No matter where telescopes are set up ... everyone wants to see the giant planets.

Sunset glowed red and gold on the face of Half Dome. Soon the Milky Way appeared. We had hours to wait 'til the giant planets were visible, and more hours 'til the moon would rise. Our first targets for the public through our two scopes, 12.5 inch and 17.5 inch reflectors varied each of the three nights. Uranus was always first in one of our scopes — we were the only telescope to starhop to the easy and bright target.

Each of the 15 or so astronomers had different targets to show. The Messier objects always get covered well at any public star party, so we chose the roads less travelled. One night I started with the E.T. cluster NGC 457 in Cassiopeia. Another night, Archid or eta Cassiopeia, the lovely double which I call "the Pink Buddy". Dark nebula B86, Barnard's Inkspot, was first sight for a while. M103 in Cassiopeia, a lovely open cluster with varied and colorful members was another great early target. Polaris was very popular, its dim companion a surprise to all. The central star in the Draco "Cat's Eye" nebula, NGC 6543, was visible with direct vision for all to see. Hundreds of celestial treats were offered up for viewing to a hungry public.

Galaxy NGC 7331, and nearby Stephan's Quintet were clear and bright enough to show the public. Not your usual public star party fare, but possible at the high elevation and transparent skies.

Everyone wanted to see Saturn and Jupiter. No matter where telescopes are set up, be it San Francisco city sidewalk or lofty granite aerie, everyone wants to see the giant planets. The sky was so transparent, the seeing so incredibly good, that the crowd got views that made even the most virile astro he-man just whimper in ecstacy.

My 12.5 and 17.5 inch reflectors were joined at cliff-edge by another Shallow Sky aficionado from our observing family here. He brought an 180mm Starfire, fitted with a Zeiss bino-viewer and coupled with barlow and twin Panoptic eyepieces. Maybe he'll share some of our photo memories of the weekend. This equipment was up to the challenge of planet views we all considered among the best in over four years. Images snapped into crisp and sharp clarity even at 600X. I usually have trouble merging the images in binoviewers, but finally was able to see the glory of Jupiter at high power through the 7 inch Starfire.

Each night yielded special planetary activity. Friday night 9/3 three Galilean moons formed a triangular arrow pointing away from the planet toward the fourth moon — a lineup I had not seen before. Saturday 9/4, the massive white oval, plumes trailing dark festoons in a riot of color contrast in the Starfire, as well as through my own 12.5 incher. A dark spot — not a

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Houston on Glacier Point

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moon — shown within the oval. A parade of smaller ovals marched in formation across the NEB. An occultation of Ganymede occurred at prime viewing time Saturday night. This added an observing treat for the public and the gathered astronomers alike. Sunday night 9/5, when I announced the Great Red Spot was visible, several of the exhausted observers got a second wind, and stayed for several more hours! The shadow transit of Europa offered a leisurely dance across the planet. Moon and moon-shadow mesmerized the crowds.

Saturn was stunning. One woman who had never looked through a telescope before counted the 5 Saturnian moons and delighted in knowing their names. This same woman happened upon the astro-fest unknowingly, and stayed 'til after 2:00 AM on Sunday night!

Sated with planet views, we waited for moonrise. The Milky Way appeared to twist in the sky as the hours passed. The moon would rise on the horizon to the right of Half Dome. We waited. I had never watched the third quarter moon rise on a dark horizon before. And never through a telescope! We lowered the big reflectors 'til they were horizontal with the ground, pointing east. We scanned the dark horizon. Stars blinked and sped through the eyepieces as they cleared the granite horizon. A red star appeared on the horizon. Betelgeuse! An hour later a fuzzy patch, a glow, appeared on the horizon. Incredibly, it was M42, the Orion Nebula! The six stars of the trapezium blinked on when they rose above the rocky landscape. At 202X through the 12.5" f/5.75 reflector I could make out the E and F stars, barely! I mentioned it was dark, didn't I?

Now we were nearing the moon rise time. At first the earthshine occulted the rising stars. The eerie moon pushed past the trees in the foreground in our eyepiece view. Mare Crisium and many lunar features were visible right on the horizon. When the "horn," one pointy tip of the crescent appeared, we let out a yelp! It was joined seconds later by the other crescent tip.

Soon the entire moon had risen above the horizon. Half dome and crescent moon, side-by-side, one nearly as beautiful as the other. We were silent, alone with our thoughts as we pondered this special view. Two rocky orbs which caused this viewer to stop for a while and honor the majesty of nature.

What could top this? Simply to return to the campground and fall dreamily to sleep. Before I had time to count the 10 moons I had observed, I was out like a light. Goodnight everybody, goodnight moon.

Report from Henry Coe

Gary Mitchell

We had the opportunity to spend Wednesday night, August 11-12, camping at Henry Coe to see the Perseid meteors. As meteor showers go, this one wasn't especially noteworthy, but the conditions for astronomy were fantastic! It's rare to have skies like this near the Bay Area.

The forecast was for low clouds and fog over much of Northern California. San Jose (at least at my house) was completely overcast. Such weather is very rare around here during this time of year. I thought the trip was going to be a bust. However, some of my previous experiences with "low clouds and fog" have been very positive. If you are high enough (e.g. Fremont Peak or Henry Coe) to be above the clouds, they block out much of the light from the cities. I've noticed that the seeing and clarity tend to be pretty good under those conditions too.

It turned out the clouds never got above about 1,500 to 2,000 feet, well below the camp area of Henry Coe. The cool marine air flowing on shore caused a fair amount of wind at first, but it settled down to a gentle breeze shortly after dark. The air was very transparent and surprisingly steady. Even more surprising since there were a few small camp fires going in the area. I suppose the breeze was sufficient to blow most of the turbulence way from where we were.

With the clear air and clouds blocking city lights from below, the conditions couldn't have been much better. Most of the lights from Gilroy were still visible, but not a problem. The Milky Way stood out well against an unusually dark sky for the location. Between catching the odd meteor, I had almost a dozen Messier objects effortlessly viewed in what seemed like no time at all.

After showing the globular cluster in Hercules (M13) so often at school star parties (around San Jose), now it was almost unrecognizable! It truly looked like a pile of salt—hundreds of individual grains glowing against a velvet backdrop—instead of the "faint fuzzy" I'd become accustomed to. And the Omega Nebula (M17), also called the "Swan Nebula," really did look like a swan in my small six inch. I was surprised at how much detail was visible.

The moral of the story: Clouds—the bane of astronomers—sometimes really do have silver linings. I'm glad to have been there for this one. Just watch for those words in the forecast: "LOW clouds and fog." Also, this being the first time observing from the camp ground area of Henry Coe, I left feeling rather good about this park for astronomy.

Mooning

Dave North

This month we have a real show going on, right in prime time! At about five minutes after 10 pm on October 18, the moon will occult Uranus from all of our Northern California sites (youse folks that are further away might want to run your own numbers on this).

It will disappear near the north pole on the dark side, and reappear about 45 minutes later a bit further south on the bright side. Both of these events should be great fun to watch.

Uranus is a bit brighter than Mag 6, so it shouldn't be hard to watch on the disappearance, but you may find the reappearance a bit more challenging.

The great thing about this is you couldn't ask for a better time schedule; you won't even have to lose much sleep to catch the whole thing.

And as a bonus, it's a great night for mooning anyway, with the terminator nearing Copernicus ... all the great Appenine features showing. Mmm!

One thing to look for: when near the moon (an almost monochrome body) the color of Uranus (no jokes now!) should be very apparent. Make sure you note what you see and compare.

That's a tough act to follow, but there are a couple of other things to note in October.

For early risers, the predawn moon at the beginning of the month will be spectacular. It will be very, very high in the sky (almost overhead!) for great seeing, and nearing first quarter.

If you do get up early, this is your time of year for some great views.

And, for those who missed the other opportunities to scope out Mare Orientale, there's another, lesser shot on the 23rd. Probably won't be a really good view due to a weak libration, but worth a glance (what else is there to do on a full moon Saturday?)

...which brings up this month's extended topic:

Libration.

What is this "libration" I'm always talking about?

First, it isn't "liberation" (end of the school year) or "libation" (though enough "libations" and "librations" seem to start happening all over the place).

The word "libration" is rooted in the word for "scale" (as in libra). What it refers to is the oscillation or rocking motion in the apparent aspect of a secondary body (as a planet or a satellite) as seen from the primary object around which it revolves.

This is, as far as I know, its only meaning.

So it's easy to see why you normally only hear this word used in reference to the moon: from our point of view, there's only one satellite we're likely to be looking at in enough detail to see this "oscillation."

What does it mean to the observer? It means the moon doesn't present exactly the same face to us all the time, but rather it rocks back and forth — and up and down. Each motion has its own "reason."

Sometimes, then, we can see more of one side or the other, and when that side is well lit, we're in business: we can see things that are normally not visible. The same is true in the north and south, of course.

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Ed Erbeck (left) receives the Dr. A.B. Gregory Award from SJAA President David North. The award is a plaque including the text "In recognition of Outstanding Contributions of Time and Effort to Others in Amateur Astronomy". It is presented once to an individual.

It was named after Dr. A. Boris Gregory, professor of French Literature, lifetime amateur astronomer, and president of SJAA 1973-4. His response to practically any question seemed to be, "Come over and let's see what we can do...." Bob Fingerhut began his talk at the September meeting (about eyepiece projection) with fond reminiscences of Dr. Gregory, who was instrumental in teaching Bob about astronomy and astrophotography. Ed joins these other inspirational members of the club who have received the award in honor of their contributions to the club in past years: 1980- Kevin Medlock, 1981-Denni Frerichs Medlock, 1982- Gerry Rattley, 1983 - Bob Fingerhut, 1984-Jim Van Nuland, 1985-Jack Zeiders, 1987- Don Machholz, 1989- Tom Ahl, 1991- Jack Peterson, Paul Barton (two awards), 1995-Bob Ashford, 1997-Bob Keller, 1998- Jay Reynolds Freeman.

Mooning Continues

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Because of the way the terminator moves, all of the directions are best seen near the full moon. Near full, more of the poles are lit and a longer stretch of polar terminator is visible.

Just before full, the terminator will be near the western side. Just after, near the east.

The notable exception to these rules is when you're looking for contrast between maria (seas; the smooth dark areas) and highlands. This is best seen in high light, so will be true for the eastern limb at first quarter, and for the western limb at third quarter. So a strong east or west libration near those times is always worth a look, too.

Why does the moon rock and roll?

Mostly, it doesn't. It does wiggle a little bit, but that hardly shows.

We see the top and bottom more because the orbit of the moon is inclined to our equator (in fact, it is fairly close to the ecliptic, varying about +-5 degrees).

When it is higher than our equator, we get a bit of a glance at the bottom. When lower, we see more of the top. As you can see, the view varies slightly for people in, say, Australia than from here.

What about east and west?

This is a bit more interesting to me. The moon has an ellipitcal orbit (as do all natural bodies; a perfect circle would be extremely unlikely).

In an elliptical orbit, any body goes faster at times (when closest to the body it orbits) and slower at others. But the Moon rotates at a fixed, regular rate — even if it's only once per orbit.

That means its rate of turn per mile travelled is smaller when it's near the earth, and higher when it is further away. Presto! The moon rocks.

(Try this with a tennis ball or something; just move it around anything while duplicating those two effects, and you'll see the libration).

Of course, it's a little more complicated than that, but those are the main ideas involved... and now you can tell all your coworkers about lunar librations, and if you say the whole thing fast enough, watch their eyes spin...

Oh, one last note: the moon almost never actually "faces" the earth at all! Its face points toward the other focus of the ellipse (where the earth isn't) and drifts back and forth around that focus. By force, this sweeps across the earth twice each orbit (near apogee and perigee) but since it's usually looking either north or south of us (just slightly) we usually aren't in its crosshairs.

How often are we? Turns out to be about the same frequency as eclipses (since the two effects are similar in nature).

Can't help it; I just think that's really a neat tango.

October Meteor Watch

David North

First up is the Draconids from October 6-10, a periodic shower.

Twice this century, the Draconid radiant produced two brief but spectacular meteor storms in 1933 and 1946. In several other years, lower rates were also observed.

Detectable activity has only been seen in years when the streams parent comet, 21P/Giacobini-Zinner, has returned to perihelion.

Whether high rates will be observed during any year is anybody's guess, but it would be worthwhile to observe on the nights of October 8th and 9th just in case. A new moon favors any Draconids that may appear.

The radiant is near Draco's head and will be circumpolar from many locations.

This is a rare event for meteor watchers due to the location of Draco high in the sky right after sunset. Your best bet would be to start observing then for about 3 or 4 hours as the radiant will be getting lower in the sky as the evening progresses.

Usually, it's best to hang around until the early morning hours, but that won't be the case this time!

Any meteors seen will appear Very Slow.

Next, the Orionids: the incoming (pre-perihelion) particles from Halley's comet. This shower is active throughout October and reaches its maximum activity between October 17 and 25.

This year there will be near full moon conditions on the peak night of Oct 21/22, bad news.

Under dark skies the highest hourly rates average near 20 but occasionally reaches 40 — so this won't really be much to see, in all odds. Under these moonlit conditions, expect at best about six Orionids/hr.

Most Orionid meteors are faint, so...

Autumn Astronomy Day

Autumn Astronomy day will once again be celebrated by Northern California clubs. The SJAA will hold it's regularly scheduled star party on Friday October 15, and the final Public Program of the season will be held at Fremont Peak on Saturday October 16th.

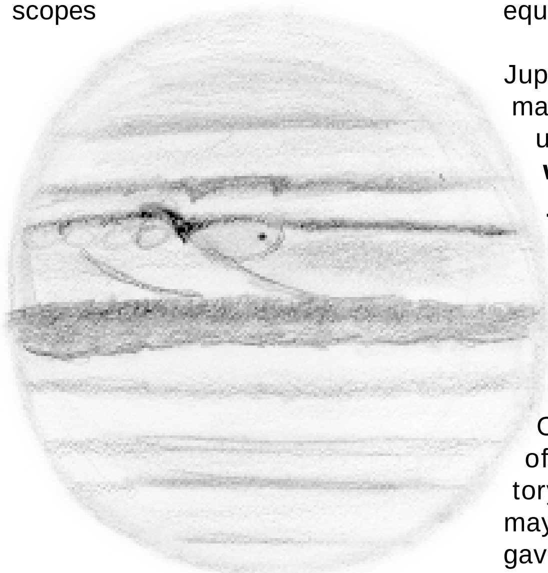
For more information, visit the AANC website at **www.lhs.berkeley.edu/sii/aanc/AstroDay.html**

The Shallow Sky

Akkana Peck

The twin giants of Jupiter and Saturn rule the October sky, high in the sky and visible most of the evening.

Jupiter reaches opposition on October 23, and outshines everything else in this month's sky. Its light and dark bands (in particular, the northern and southern equatorial belt, denoted NEB and SEB in Jupiter-watcher parlance), and its moons and their tiny, intensely black shadows on the planet's disk, should be visible in any telescope. Transits of the moons themselves are more difficult to see, but are still possible even in telescopes



Jupiter sketched by Jane Houston, September 4, 1999, Glacier Point, through William Phelps' 7" Astro-Physics Starfire refractor

as small as 80mm.

It's fun to watch moon and shadow transits just before and after opposition: the moon and shadow are so close that they overlap. For example, the Io transit on the night of October 19 looks like it should be an excellent one, with Io and its shadow following the Great Red Spot across Jupiter's disk.

The Great Red Spot, or GRS for short, is great indeed, but isn't very red; look for a split in the SEB where the belt separates into two pieces which encircle a large light-colored oval area. This area is known as the GRS Hollow, and is sometimes the only visual indication of the GRS itself. Steadier seeing and good optics can show more, including swirls inside the GRS, and white ovals preceding and following the GRS hollow indicating turbulence caused by the massive long-lasting storm that is the GRS.

An SJAA member has reported that this year, the NEB seems unusually active, with dark spots and festoons (long trailing wisps extending into the light-colored equatorial zone)

You can get transit times for Jupiter's moons and for the GRS in magazines like Sky & Telescope, or use my Java applet:
www.shallowsky.com/jupiter.html

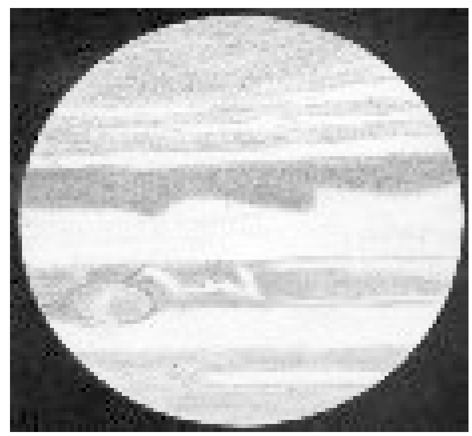
Two other excellent Jupiter observation links on the web are:
chabot.cosc.org/~eas/r1198-4.htm

(Jose Olivarez' Jupiter Observations: Olivarez is Director of Astronomy at Chabot observatory in Oakland, and SJAA members may remember the excellent talk he gave last year on observing Jupiter.)
members.xoom.com/Zac_Pujic/jupiter.html

(A great overview of Jovian features, though it hasn't been updated yet this year.)

When you get tired of watching Jupiter, switch your attention to Saturn, the bright star below and to the left of Jupiter. Saturn's rings show a generous tilt, though they are not quite as open as they were a few months ago, and will present a dazzling sight in any telescope. Look for Cassini's division, a narrow gap between the two main (A and B) rings, and for the semitransparent C or "Crepe" ring inside the main rings. In steadier seeing, try for the much more difficult gaps in the outer A ring; these gaps seem to change with time and not all observers see them the same way, so take a look and see what you can see there!

Mars is low in the western sky at nightfall, but that doesn't mean it's not worth observing: on the 18th, it passes near the Lagoon nebula, and on the 24th it will pass



Jupiter sketch by the Author, October 1998, 128mm refractor.

near the globular cluster M28. Though Mars itself is too far away to show much detail now, it should be a fun low-power target as it passes close to these other objects.

Uranus and Neptune are still observable, close together in central Capricornus. Pluto sets earlier, and is really too low to be a good target this month. Mercury is back in the evening sky, but just barely; it'll be a difficult find. Venus, near half phase now, shines in the morning sky.

Next Month in the *SJAA Ephemeris*: Euro-eclipse reports from Ernie Piini and Robert Garfinkle

Comet Comments for October 1999

Don Machholz

Comets 1998 T1 (LINEAR) and 1999 N2 (Lynn) are fading in our evening sky, but three other comets are visible in our instruments. We have been watching Comets Lee and Temple 2, now we can see the new Comet LINEAR (1999 J3). Discovered on May 12, it has left the polar region and entered our morning sky, brightening rapidly. Imagine my surprise when I recently swept it up while comet hunting, not knowing it would be so bright.

Only one new comet has been found, and this was by SOHO on August 5. No comets were found during the total solar eclipse of August 11.

COMET HUNTING NOTES: The tilt of the comet's orbit is called the inclination, and it is measured in degrees. A comet going in earth's orbit has a 0 degree inclination, while one going in the opposite direction has a 180 degree inclination. An object traveling perpendicular to earth's orbit (as does Comet Hale-Bopp) has an inclination of 90 degrees. The average inclination for the last 81 visually found comets is 84 degrees. There is a slight grouping of comets in the 40-50 degree range and a dearth of comets near 100 degrees. I suspect this is a true picture of comet orbit distribution, since comet hunter sweeping patterns would not seem to favor (and unfavor) these particular inclinations.

Comet Ephemerides

C/1999 H1 (Lee)

Date(00UT)	R.A. (2000)	Dec	El	Sky	Mag
09-09	05h33.3m	+54d58'	82d	M	8.4
09-14	04h50.1m	+57d36'	92d	M	8.4
09-19	03h51.4m	+59d13'	102d	M	8.5
09-24	02h40.3m	+58d43'	114d	M	8.6
09-29	01h29.8m	+55d19'	125d	M	8.7
10-04	00h32.2m	+49d27'	135d	M	9.0
10-09	23h50.6m	+42d22'	141d	M	9.2
10-14	23h21.8m	+35d16'	142d	E	9.6
10-19	23h02.0m	+28d51'	140d	E	9.9
10-24	22h48.4m	+23d23'	135d	E	10.3
10-29	22h39.0m	+18d51'	129d	E	10.7
11-03	22h32.6m	+15d10'	123d	E	11.0
11-08	22h28.4m	+12d09'	117d	E	11.4

Periodic Comet Tempel 2 (P/10)

Date(00UT)	R.A. (2000)	Dec	El	Sky	Mag
09-09	18h11.8m	-29d01'	107d	E	10.7
09-14	18h25.2m	-29d54'	105d	E	10.8
09-19	18h39.3m	-30d37'	103d	E	10.9
09-24	18h54.1m	-31d09'	101d	E	11.0
09-29	19h09.4m	-31d31'	99d	E	11.1
10-04	19h25.0m	-31d41'	98d	E	11.2
10-09	19h40.9m	-31d41'	96d	E	11.3
10-14	19h56.9m	-31d31'	95d	E	11.4
10-19	20h12.9m	-31d11'	93d	E	11.6
10-24	20h28.9m	-30d41'	92d	E	11.7
10-29	20h44.6m	-30d03'	90d	E	11.8
11-03	21h00.0m	-29d16'	89d	E	12.0
11-08	21h15.2m	-28d23'	88d	E	12.1

1999 J3 (LINEAR)

Date(00UT)	R.A. (2000)	Dec	El	Sky	Mag
09-04	08h39.9m	+49d15'	50d	M	10.1
09-09	08h34.9m	+46d29'	53d	M	9.8
09-14	08h29.5m	+43d11'	56d	M	9.5
09-19	08h23.7m	+39d05'	59d	M	9.3
09-24	08h17.5m	+33d54'	63d	M	9.0
09-29	08h10.7m	+27d08'	67d	M	8.8
10-04	08h02.8m	+18d09'	71d	M	8.5
10-09	07h53.5m	+06d13'	77d	M	8.3
10-14	07h41.9m	-08d55'	82d	M	8.2

Continued next column

1999 J3 (LINEAR) Continued

Date(00UT)	R.A. (2000)	Dec	El	Sky	Mag
10-19	07h26.8m	-26d03'	87d	M	8.3
10-24	07h06.1m	-42d25'	91d	M	8.6
10-29	06h37.1m	-55d39'	92d	M	9.0
11-03	05h55.8m	-65d07'	91d	M	9.5
11-08	04h59.2m	-71d08'	90d	M	10.0

Elements

Object:	Lee
Peri. Date:	1999 07 11.1725
Peri. Dist (AU):	0.708101 AU
Arg/Peri (2000):	040.7006 deg.
Asc. Node (2000):	162.6490 deg.
Incl (2000):	149.3533 deg.
Eccen:	0.99974
Orbital Period:	142,000 yrs.
Ref:	MPC 35553
Epoch:	1999 08 10
Absol. Mag/"n":	7.0/4.0

Object:	P/Tempel 2
Peri. Date:	1999 09 08.41663
Peri. Dist (AU):	1.481683 AU
Arg/Peri (2000):	195.02016 deg.
Asc. Node (2000):	118.21147 deg.
Incl (2000):	011.97662 deg.
Eccen:	0.5228125
Orbital Period:	5.47 years
Ref:	NK640
Epoch:	1999 08 10
Absol. Mag/"n":	9.0/5.0

Object:	LINEAR (1999 J3)
Peri. Date:	1999 09 20.1699
Peri. Dist (AU):	0.9774750AU
Arg/Peri (2000):	161.9509 deg.
Asc. Node (2000):	229.0006 deg.
Incl (2000):	101.6670 deg.
Eccen:	1.0
Orbital Period:	Long Period
Ref:	MPC 35553
Epoch:	1999 09 20
Absol. Mag/"n":	9.4/4.0

Celestial Calendar October 1999

Richard Stanton

LUNAR PHASES:			Date	Rise	Trans	Set
LQ	21:02	PDT	01	00:06	06:29	13:50
NM	04:34	PDT	09	07:15	13:18	19:14
FQ	08:00	PDT	17	14:23	19:30	00:39
FM	14:02	PDT	24	18:46	01:24	07:01
LQ	05:04	PST	31	00:05	06:16	13:25

NEARER PLANETS: R. A. Dec.

Mercury … 1.14 A.U., Mag. -1.8

				R. A.	Dec.
07	08:48	14:08	19:27	14:01.4	-13:44
17	09:19	14:20	19:21	14:53.3	-19:02
27	09:35	14:24	19:13	15:37.4	-22:27

Venus … 0.58 A.U., Mag. -5.2

				R. A.	Dec.
07	03:36	10:09	16:41	10:03.5	+09:06
17	03:34	10:02	16:29	10:35.8	+07:30
27	03:39	09:59	16:18	11:11.9	+05:04

Mars … 1.44 A.U., Mag. +0.2

				R. A.	Dec.
07	12:55	17:34	22:13	17:29.2	-25:03
17	12:48	17:26	22:05	18:00.7	-25:12
27	12:40	17:19	21:59	18:32.9	-24:56

Jupiter … 3.96 A.U., Mag. -2.9

				R. A.	Dec.
07	19:26	02:07	08:44	02:01.8	+10:46
17	18:43	01:23	07:59	01:59.9	+10:19
27	18:00	00:39	07:13	01:51.8	+09:51

Saturn … 8.26 A.U., Mag. +0.5

				R. A.	Dec.
07	20:10	03:02	09:51	02:57.1	+14:08
17	19:29	02:20	09:08	02:54.5	+13:56
27	18:47	01:38	08:25	02:51.5	+13:42

SOL Star Type G2V Intelligent Life in System ?

Hours of Darkness

09:32	07	07:07	12:56	18:43	12:50.0	-05:21
09:55	17	07:17	12:53	18:29	13:26.9	-09:07
10:16	27	07:27	12:52	18:16	14:04.7	-12:39

Astronomical Twilight:

		Begin	End
JD 2,451, 458	07	05:41	20:09
468	17	05:50	19:55
478	27	05:59	19:43

Sidereal Time:

Transit Right Ascension at Local Midnight

07	00:00	=	23:54
17	00:00	=	00:33
27	00:00	=	01:13

Darkest Saturday Night:09-Oct-1999

Sunset	18:40
Twilight End	20:06
Moon Set	19:15
Dawn Begin	05:43
Hours Dark	09:37

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SJAA Loaner Scope Status

All scopes are available to any SJAA member; contact Mike Koop by email (koopm@best.com) or by phone at work (408) 473-6315 or home (408) 446-0310 (Leave Message).

Stored Scopes

These are scopes that are available for immediate loan, stored at other SJAA members homes. If you are interested in borrowing one of these scopes, please contact Mike Koop for a scope pick up at any of the listed SJAA events.

# Scope	Description	Stored by
3	4" Quantum S/C	Manoj Khambete
30	7" f/9 Newt/Pipe Mount	Mike Koop

Current Scope Loans

These are scopes that have been recently loaned out. If you are interested in borrowing one of these scopes, you will be placed on the waiting list till the scope becomes available after the due date.

# Scope	Description	Borrower	Due Date
1	4.5" Newt/ P Mount	Michael Masten	09/30/99
6	8" Celestron S/C	David Artiaga	11/06/99
7	12.5" Dobson	Jeff Crilly	10/10/99
8	14" Dobson	Darryl Lambert	09/04/99
15	8" Dobson	Phil Robba	06/27/99
16	Solar Scope	Bill Maney	08/23/99
18	8" Newt/ P Mount	Gordon A McClellan	10/09/99
21	10" Dobson	Ralph Seguin	09/04/99
23	6" Newt/ P Mount	Glenn Yamasaki	09/04/99
24	60mm Refractor	Scott McGrew	09/04/99
26	11" Dobson	Nilesh Shah	08/01/99
28	13" Dobson	Bill Sweeney	07/25/99
29	C8, Astrophotography	Dean Sala	09/04/99
31	8"/f8 Dobson	Lee Barford	10/23/99

Extended Scope Loans

These are scopes that have had their loan period extended. If you are interested in borrowing one of these scopes, we will contact the current borrower and try to work out a reasonable transfer time for both parties.

# Scope	Description	Borrower	Due Date
2	6" f/9 Dob	John Paul De Silva	?
4	60mm Refractor	Del Johnson	Indefinite
9	C-11 Compustar	Paul Barton	Indefinite
19	6" Newt/P Mount	Hsin I Huang	11/21/99
27	13" Dobson	Bud Wittlin	08/01/99

Notes:

If you know how to contact John Paul De Silva please call Mike Koop.

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