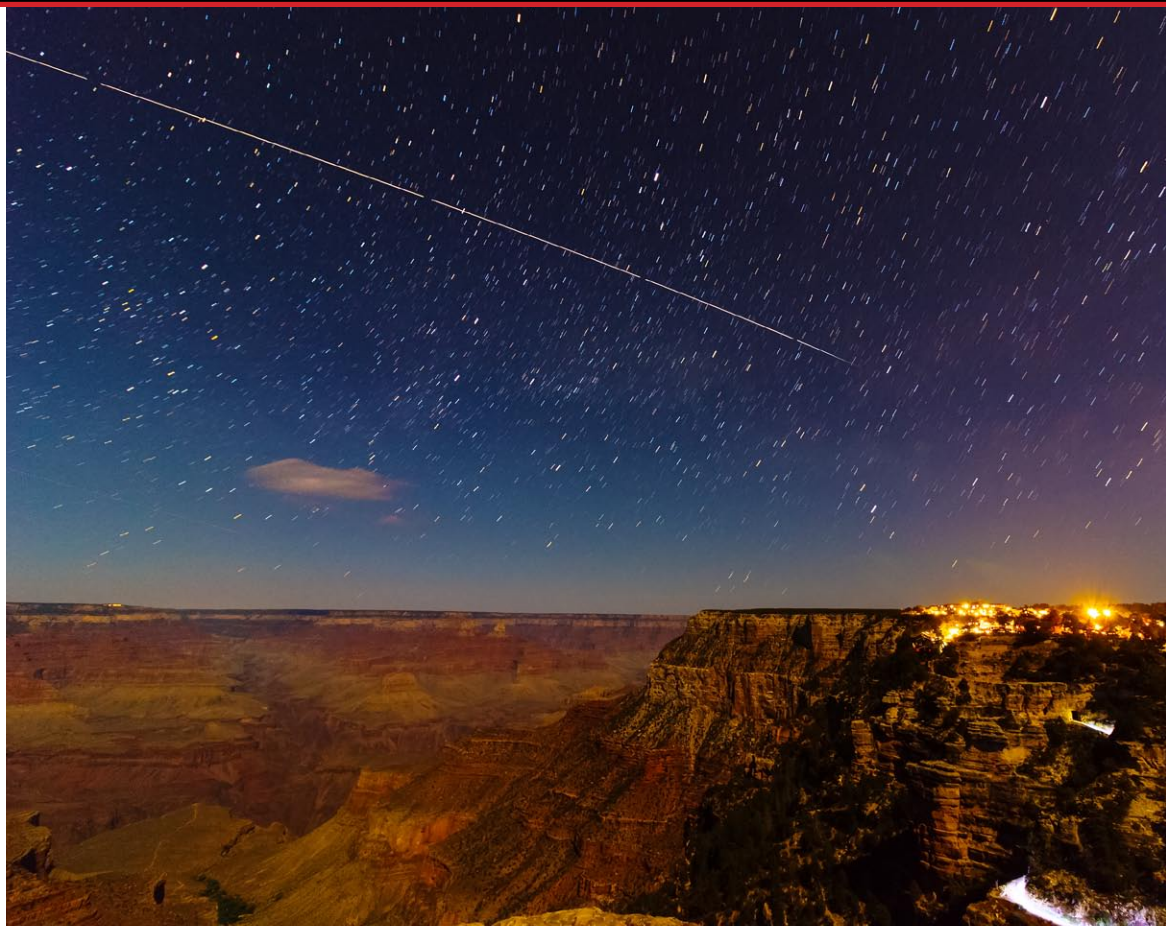
The Denver
OBSERVER
JUNE 2018



The International Space Station (ISS) passes overhead at the Grand Canyon, June 2016. The star trails and ISS's streak result from a total exposure time of about 2½ minutes.

Image: © Sorin 2018 SoggyAstronomer.com

JUNE SKIES

by Zachary Singer

Solar System

Mercury begins June lost in dawn's light; by the end of the month, the fast-moving planet is an *evening* object, roughly half-lit and 10° above the western horizon, a half-hour before sunset. At that point, the planet spans nearly 7" of arc and shines brightly at magnitude 0. (Though Mercury will be more than a magnitude brighter mid-month, it will sit only two or three degrees above the horizon as darkness falls, making it a challenging target.)

Venus will be a bright, beautiful, and easy object all month. It glows at -4 magnitude throughout June, starting the month as clearly gibbous (about 80% lit), with a 13" disk. By month's end, the planet's phase will be closer to "lemon wedge," though technically still gibbous, and the disk will grow to 16". (The disk's growth relates directly to Venus coming some 20% closer to us, from 1.26 astronomical units [AU] at the beginning of the month, to just 1.00 AU at the end.)

Mars is big, and it's getting bigger! The red planet starts June off with a disk 15.5" across—definitely large enough to see surface detail—and already bright at -1.2 magnitude. On a late-night observing run in the last week of May, Mars was 14" across, but I could make out some blurry detail: The broad swath of Aonia Terra in the south of Mars was visible in my 6-inch Newtonian, as was the huge dark band that separates it from the area near Valles Marineris. (A good smartphone-based astronomy app can show you which Martian features are facing us at

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Sky Calendar

6	Last-Quarter Moon
13	New Moon
20	First-Quarter Moon
27	Full Moon

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The Observer is available in color PDF format from the DAS website: http://www.denverastro.org/das/denver-observer/

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PRESIDENT'S MESSAGE *by Ron Hranac*

A Matter of Perspective

Those of us who live along Colorado's Front Range enjoy a pretty good place from which to observe the sky—our often-mediocre seeing and light pollution notwithstanding. To the north is Alpha (α) Ursae Minoris, better known as Polaris, the North Star or Pole Star; it's so-named because it's situated at nearly the north celestial pole. From the Denver metropolitan area, Polaris is approximately 40° above the northern horizon. The significance of the elevation of Polaris is that it is about equal to the Denver area's latitude above the Earth's equator (Baseline Road in Boulder is located almost exactly on the 40° north line of latitude). Indeed, measuring the elevation of Polaris in degrees above the horizon, from anywhere in the northern hemisphere, gives your approximate latitude north of the equator, also in degrees. Polaris has a long history of being a navigation aid for travel in the northern hemisphere!

From our vantage point facing north, we can also enjoy views of certain constellations, asterisms, and stars that never set; they're called circumpolar. You've probably seen long-exposure astrophotos that show the trails of stars tracing circles (or parts of circles) around the north celestial pole. The star trails that remain unbroken (the circles or arcs that don't touch the ground) are those that don't set—the greater your latitude, the more circumpolar stars there are.

If we face south, the ecliptic lies upward and in front of us. The ecliptic is an imaginary line marking the Sun's position through the year—in another sense, it's the plane of our own orbit around the Sun. Because the Moon and planets have orbits in similar planes to ours, they can be found near the ecliptic, too. As we look in the direction of the ecliptic at night, we get a nice view of the Moon and planets, seasonal constellations and other objects that *rise on our left* (east) and *set on our right* (west). If you think about it, the waxing Moon is a familiar sight near the ecliptic during most Denver Astronomical Society monthly Open Houses; it's often at or close to its first quarter phase.

One of my favorite constellations is Orion the Hunter, visible in Denver's southern sky during winter and spring. As we look at Orion, the red supergiant star Betelgeuse

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DAS SCHEDULE

June 2018

1	E-Board Meeting—At DU's Historic Chamberlin Observatory, 7:30 PM. All members welcome.
2	DAS Member In-Reach—At DU's Chamberlin Observatory, 7:30 PM
13	Rocky Mountain Star Stare
16	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
23	Open House—DU's Historic Chamberlin Observatory—Starts at 8:00 PM
29	DAS General Meeting—DU's Olin Hall, Rm. 105—Starts at 7:30 PM

(July 2018)

6	E-Board Meeting—At DU's Historic Chamberlin Observatory, 7:30 PM. All members welcome.
7	DAS Member In-Reach—At DU's Chamberlin Observatory, 7:30 PM

During Open House, volunteer members of the DAS bring their telescopes to the Chamberlin Observatory's front (south) lawn, so the public can enjoy views of the stars and planets, try out different telescope designs, and get advice from DAS members. The Observatory is open, too (costs listed below), and its historic 20-inch telescope is open for observing with no reservations necessary.

Open House costs (non-members): If the skies are clear, $2/person ($5/family), $1/person in inclement weather. DU students with ID, and DAS members free.

Public Nights feature a presentation on astronomical subjects and a small-group observing session on the historic 20-inch telescope (weather permitting), at Chamberlin Observatory on Tuesday and Thursday evenings (except holidays), beginning at the following times:

March 10 - September 30 at 8:30 PM

October 1 - March 9 at 7:30 PM

Public Night costs (non-members): $4/adult, $3/child and students with ID. DAS members and DU students with ID: free.

Members of the public (non-DAS/DU, as above), please make reservations via our website (*www.denverastro.org*) or call (303) 871-5172.

President's Message

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(Alpha [α] Orionis) marks the upper-left side of the constellation, and blue-white supergiant Rigel (Beta [β] Orionis) the lower right-side of the constellation. We see the brightest star in the night sky, Sirius (Alpha [α] Canis Majoris), to the lower-left of Orion. These positions are familiar to us, from our perspective at about 40° north latitude, but they would appear to shift at different latitudes—subtly, if we head a few degrees north or south, but dramatically as we approach or cross the equator.

Back in April, I had an opportunity to travel to Buenos Aires, Argentina for business. While the view of the night sky is diminished by light pollution (Buenos Aires proper has a population of nearly 3 million—and the larger metropolitan area, about 13 million), it is possible to see brighter stars, planets, and the Moon. Buenos Aires is located at about 34° *south* latitude, so there is no way to see Polaris or some of the northern constellations we can see from Colorado, but others remain visible.

One thing I enjoy about views of the night sky from Buenos Aires is the "upside-down" perspective! Because of the city's location in the southern hemisphere, the ecliptic lies in the *northern* part of the sky. That means when facing toward the ecliptic, the Sun, Moon, planets, and seasonal constellations and stars rise on the *right* (east) and set on the *left* (west).

Looking *north* from outside of my hotel, Orion the Hunter was *nearly upside-down* in the sky (compared to our upright view of it in Denver). Rigel was in the *upper-left* part of the constellation, and Betelgeuse in the *lower-right*. Sirius was *above* Orion! The waxing Moon was upside-down, too, and the illuminated part of the disk was on the left.

The difference comes from our usual *standing* positon when we view the sky—in the southern hemisphere, Orion and the constellations near it are so far above and *behind* you that you'd lose your balance if you tipped your head back enough to see them. So we turn around and face north—voilà, Orion is upside-down, and stars rise on our right. This orientation is accompanied by a whole slew of "new" constellations visible in the south that we can't see at our northern latitude. The view is something that should be on every northern hemisphere-based amateur astronomer's bucket list.

June Skies

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any given time, useful for both identification and planning.)

By mid-month, Mars will grow to a full 18", the same span as our best view two years ago—and it will brighten by half a magnitude, too. The planet will rise a few minutes before 11:30 PM, half an hour earlier than at the beginning of the month, and transits (appears highest in the sky) soon after 4 AM. (Mars will be high enough to be a target by 2 AM, but you'll get a sharper view after 3, when the planet sits a little higher above the horizon.) By the end of June, Mars will cover a full 21", transiting about an hour earlier, so reasonable views will be available around 2 AM. It will brighten yet again by almost another half-magnitude, finishing the month at a bright magnitude -2.1.

Next month, things will improve still further (including the time of night), but you should make an effort to start observing now, if you can, in spite of the hour. Experienced observers will tell you that in past oppositions, the Martian surface can be obscured for days or even weeks by random dust storms, one good reason to take the opportunity while it's there. Another factor is that Mars' orbit will take the planet a bit lower in our local sky as we near opposition (that is, when Mars will be at or near its most advantageous position, from our point of view on Earth). In practice, this will mean that just as things should be at their best, late next month, we'll be giving up a little ground, so the difference between views at the end of this month and those at the end of July won't be quite as much as they might seem—might as well look early!

Jupiter was at opposition last month, so you'd expect it to appear at a convenient hour now, and it does—it rises just after 6 PM

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ABOUT THE DENVER ASTRONOMICAL SOCIETY

Membership in the Denver Astronomical Society is open to anyone wishing to join. The DAS provides trained volunteers who host educational and public outreach events at the University of Denver's Historic Chamberlin Observatory, which the DAS helped place on the National Register of Historic Places. First light at Chamberlin in 1894 was a public night of viewing, a tradition the DAS has helped maintain since its founding in 1952.

The DAS's mission is to provide its members a forum for increasing and sharing their knowledge of astronomy, to promote astronomical education to the public, and to preserve DU's Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver.

The DAS is a long-time member in good standing of the Astronomical League and the International Dark Sky Association.

The DAS is a 501 (c)(3) tax-exempt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the DAS General Fund, and the Edmund G. Kline Dark Site Fund.

***JOIN US!** More information about DAS activities and membership benefits is available on the DAS website at www.denverastro.org.

ASTRO UPDATE

by Don Lynn

Selected Summaries of Space News

TESS

On April 18th, a SpaceX Falcon rocket launched NASA's next exoplanet-finding space telescope, Transiting Exoplanet Survey Satellite (TESS), to begin a planned two-year mission. It will perform a gravity-slingshot maneuver by the Moon in order to reach its unusually elongated science orbit. Like its predecessor, Kepler (which is nearing its end of life), it will watch hundreds of thousands of stars continually to detect the slight dimming when a planet passes in front (this is the transit method of planet search). But there the resemblance ends. TESS is designed for different classes of stars and planets than Kepler, so has these feature differences:

* TESS has a field of view over 5% of the sky, while Kepler's is ¼ of 1%.
* TESS stares at a part of the sky for a lunar month, then moves to a new area, while Kepler stared at just one area for years.
* TESS sees quite a way into the infrared (in addition to some visible light), while Kepler is sensitive mostly to visible light.
* TESS has a very elliptical orbit about Earth, while Kepler is in solar orbit.
* TESS will cover most (85%) of the sky, looking for somewhat brighter stars (and therefore closer to Earth on average). Closer and brighter means more chance to follow up by taking spectra with other telescopes to learn more about the composition of planets and their atmospheres, as well as measuring planetary masses.
* TESS is more sensitive to red dwarf stars, the most common star type, which give off much of their light in infrared. TESS is looking for short-period exoplanets; it does not watch an area long enough to find the long-period planets. However, the pattern that will be used for moving the field of view each month will overlap completely near the poles of the sky, so TESS will cover these areas for a full year, and so will find *some* long-period planets.
* TESS will be able to transmit much more data to Earth, which it will do during the close approaches of its elliptical orbit. The far portion of its orbit is necessary to keep that big glowing ball of our planet from degrading TESS's images. The period of TESS's orbit about Earth is exactly half a lunar month, designed to keep the Moon out of its way also.
* TESS has four telescopes and 16 CCDs to achieve its huge field of view. Kepler found a few thousand planets (and thousands more planet-candidates are still being checked out by other telescopes for confirmation), yet with all these differences, TESS is expected to find roughly the same number (best estimate, about 4500 exoplanets). Look for a lot of amazing discoveries from TESS over the next two years, or longer if its mission gets extended.

InSight

On May 5th, an Atlas V rocket launched the next Mars lander, named InSight (for INterior exploration using Seismic Investigations, Geodesy and Heat Transport), to begin a mission of about one Martian year (687 Earth days) probing the interior of the Red Planet. Its two main instruments are a seismometer and a burrowing heat probe to measure how much heat is escaping from the interior. Both these instruments will be placed on the surface near the lander using a robotic arm.

The seismometer is actually triplicated to measure motion in three dimensions, and again duplicated to measure different frequencies of motion, resulting in six instruments. The arm will place a dome over the instrument package to protect it from Martian weather. In addition, there are two weather stations on the lander, not only to track weather, but also to determine if the weather is inducing any spurious indications in the seismometers.

The only other time seismic measurements have been made on Mars was by the Viking landers in the 1970s, but little data was obtained due to a hardware failure and interference by Martian weather. Seismometers were planned for four missions since Viking, but all those missions failed, were cancelled, or postponed. The InSight seismic instruments should allow measurement of marsquakes, interior structure of the planet, and rate of meteorite impact.

The heat probe will hammer itself as much as five yards into the soil (limited by its tether wires). It will measure temperatures and heat conductivities through surrounding soil at various points along its burrow. Heat flow is helpful in interpreting seismic data and in building computer models of the planet's interior. Our understanding of the interior of the Moon was greatly advanced when the Apollo 15 mission drilled into the surface and took heat measurements.

Further science will be done by radio tracking of the lander, so precise that wobbles of *inches* in the axis of the planet's rotation will be measured. These wobbles can reveal the distribution of mass within the planet. Also aboard is the first magnetometer to land on Mars. A retroreflector will also be placed on the surface for future use by laser altimeters on Mars orbiters.

The lander is built largely on the plan of the highly successful Phoenix polar lander, though InSight will land near the equator. The landing location (Elysium Planitia) was chosen for safety in landing and sufficient sunlight for its solar panels, since nearly anywhere on the planet is equally good for seismic and heat measurements. It will land similarly to Phoenix, using a heat shield, a parachute, and finally retrorockets. Its nearest neighbor will be the rover Curiosity, over 300 miles away.

InSight was the first launch of a planetary mission from Vandenberg, California, and the first sent into polar Earth orbit before proceeding to deep space. Launch from Florida or Guiana is considerably more efficient in attaining Earth orbit, due to those locations using the Earth's rotation to boost launch speed. However, the rocket used had sufficient energy to launch polarly (the only direction of launch from California, for safety reasons), and the launch schedule from Florida was quite crowded this year.

InSight will land on Mars November 26th. It will land on the side *away* from Earth at the time, so radio contact during landing will be through relay spacecraft. Two tiny (smaller than a breadbox) relay spacecraft were launched piggyback on InSight, and will perform this task.

Supernova Survivor

In 2001, a supernova was observed in galaxy NGC 7424. Since the afterglow of that explosion has now faded, the Hubble Space Telescope was able to find the companion star that orbited the one

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DAS NEWS

June General Meeting

Join us on **Friday, June 29th, 2018, at 7:30 PM,** for our General Meeting and a presentation by **Digby Kirby** and **Stuart Hutchins** of the DAS.

They will fill us in on their four-year odyssey to build a 17.5-inch Dobsonian, the "DAS 444" (the telescope's aperture in millimeters). This instrument, shown at right, re-purposed the already impressive optics from an older 'scope belonging to DAS, redesigning the mirror mounts and pretty much everything else along the way (apart from the mirror and focuser, it's all new). The crew will share their experiences and tell us what we can expect from this more-refined and versatile telescope—they anticipate completion in the next several months.

Stuart Hutchins has an educational background in physics, mechanical engineering and a Master's in Electrical Engineering. He has always enjoyed designing and building things of wood and metal, and made custom cabinetry and pursued home remodeling during the '90s before retiring and joining DAS in the early 21st century.

He built a 4.25-inch reflector in 1970. Thirty-three years later, he ground and polished an 8-inch mirror and designed and built a unique wood fork mount with OTA. He also taught amateur mirror-making at Chamberlin for two years.

Digby Kirby has been an active member of the DAS for the past seven years. He is currently a team lead for Public Night Teams 3 and 6, and is the New Member Ambassador for the DAS. He is happily retired from two prior careers in advertising and in medicine where he practiced as an emergency department physician assistant. Digby was bitten by the astronomy bug in grade school, and his wife Pamela Morrow-Kirby is a budding astronomer as well. Aside from astronomy, Digby has a passion for motorsports, having been an amateur racer of cars and motorcycles with experience in design and fabrication. Currently Digby enjoys bicycling and is an avid sports fan. He is a music and movie buff and a patron of the visual and performing arts.

A reception following the meeting will be held at DU's Historic Chamberlin Observatory. Coffee and light refreshments will be served.

Are you skilled at editing videos?

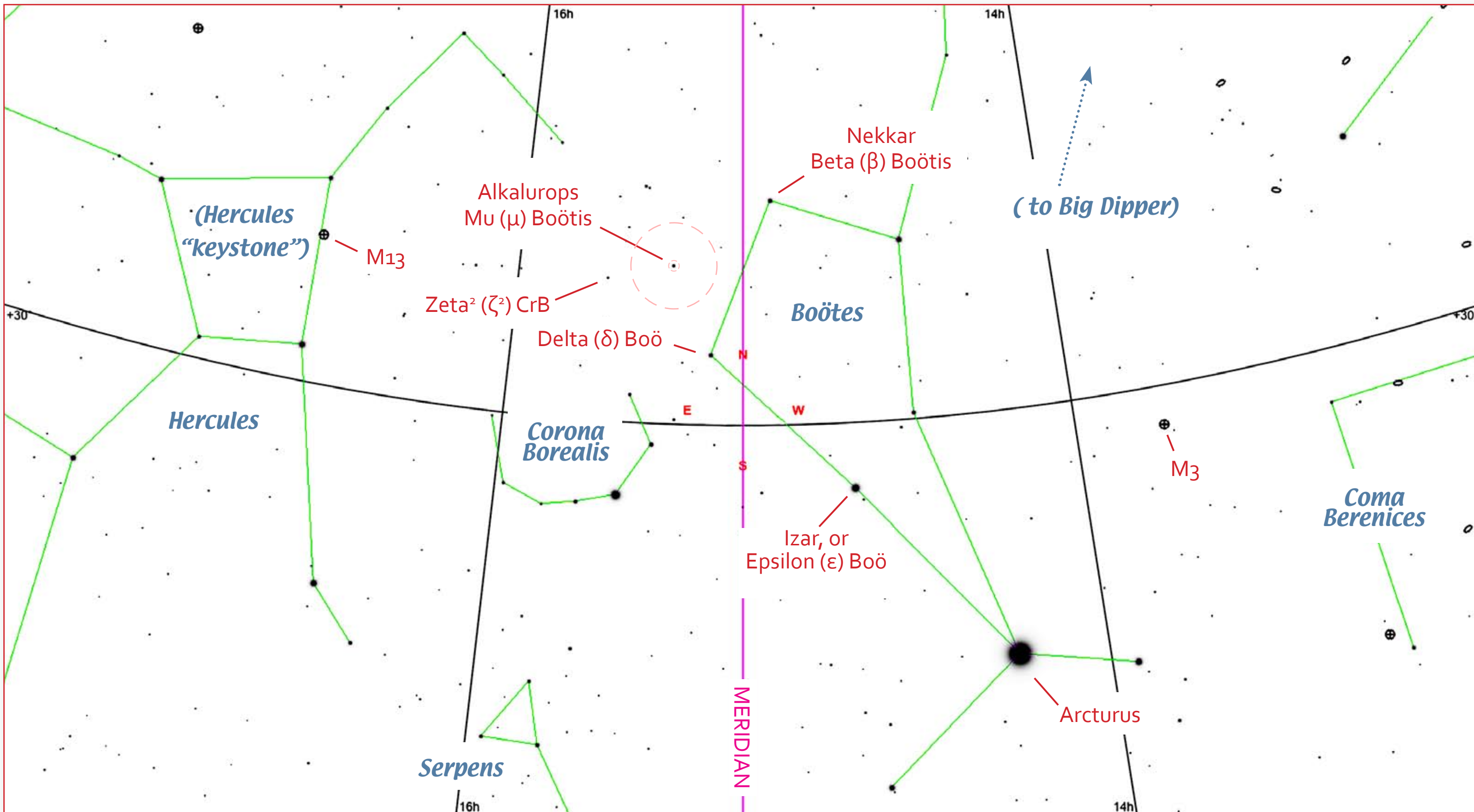
We now have Mark Cary editing some of our videos (thanks, Mark!), but he can still use a hand: If you're familiar with iMovie (or more advanced software like Final Cut Pro or Adobe Premiere Pro), how about working with Mark to edit videos of our General Meetings, for posting on YouTube?

A "how-to" guide has been created by Jeff Tropeano.

If you're interested, **please contact Darrell Dodge at dmdodge@aol.com.**

DAS Gets a Treasurer

DAS is pleased to announce that we have a new treasurer, DASer Scott Perrin—he has years of previous experience as a treasurer with non-profits. Welcome aboard to Scott, and thanks once again to Michael Nowak for his service to the DAS!



Viewing due south and 80° up in Denver at 10:30 PM in mid-June. ***Note Telrad circles centered on Alkalurops, Mu (μ) Boötis—a quick slew towards the Hercules "keystone" will bring Zeta2 (ζ2) CrB into your finderscope.*** **(Telrad's mid-sized, 2°, circle is omitted for clarity.) Other objects, like M3, are included for reference.**

Object positions, constellation and meridian lines charted in SkySafari, and then enhanced.

June Skies

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at the beginning of June and transits at 11:15 PM. (It's at a reasonable height for observation an hour earlier, just about the time the sky is getting dark.) By month's end, Jupiter transits just after 9 PM—convenient indeed! —and appears only slightly smaller at 41" across. *Now is a great time to see this object.* Look for it in Libra, very close to Zubenelgenubi, aka Alpha (α) Librae. (Almost serendipitously, the star is an interesting binary, wide enough to be seen in binoculars—check it out together with Jupiter....)

Saturn, famous for its rings, breaks the eastern horizon just after 10 PM in early June, but still doesn't transit until nearly 3 AM. In spite of that, you'll have a respectable view by about 1 AM, and the planet will be almost at maximum height (and therefore sharper-looking) by 2 AM. Saturn's opposition is on the 27th of this month; by then, you can expect the planet to transit closer to 1 AM and to present itself reasonably well by 11 PM (and sharper by midnight). So get ready for Saturn, too! You'll find it shining at 0 magnitude, right over Sagittarius's "teapot" all month.

Uranus will still be too low on the horizon to make a good target as June begins. But by the end of the month, diehard Uranus observers will find it more than 25° above the eastern horizon at 4:00 AM. It will be slightly higher at 4:30; but time will be drawing short, as sunrise comes just an hour later. Uranus lies about 4° east of Omicron (ο) Piscii in late June.

Neptune is likewise an early-morning object, best positioned around 4 AM. It's about 23° up in the southeast at that hour at the beginning of June, and nearly 40° up at the same time at the end of the month. Neptune has moved eastward since we saw it last, and now resides about 1° west of Phi (ϕ) Aquarii, and a little more than 4½° from Hydor, aka Lambda (λ) Aquarii.

Finally, there's **Vesta**: The minor planet has picked up almost a magnitude of brightness since last month, and it will get all the way down to magnitude +5.3 by June 21st—in dark skies, *well within naked-eye visibility*. Just a few days earlier, Vesta will pass the open cluster M23, providing a landmark for your search—the two will remain within a Telrad- or finderscope-*radius* of each other from about the 8th to the 21st (that is, centering one will include the other in the field of view).

Stars and Deep Sky

This month, we revisit double stars in or near Boötes—there sure are lot of them! We did the same at this time last year, concentrating on targets that were near the bottom of Boötes' "kite" shape, and therefore not far from the bright star Arcturus. (You'll find last year's binaries on page 6 of the June '17 issue, at http://www.denverastro.org/xobserver/june2017_denverobserver.pdf.) This year, we'll be up at the top of the kite; one of the stars technically belongs

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June Skies

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to the adjacent constellation of Corona Borealis, but it has an easy approach through Boötes.

Before we get going, though, a quick note about Arcturus—it's the key to finding Boötes easily. As I noted last year, Arcturus isn't just the brightest star in Boötes, *it outshines every other star for at least 60° in all directions*. It sits very high and due south at 10:30 PM as the month begins, and moves a degree westward each night after, but it will remain obvious. To confirm you've got Arcturus, *follow the curve of the Big Dipper's handle away from the bowl*—the handle arcs directly toward Arcturus. (Note that Arcturus is about as far from the end of the Dipper's handle as the handle is from the far side of the bowl.) Once you get used to finding Arcturus at the end of the Dipper's handle, you'll see that it makes a very useful landmark!

Our first target is **Alkalurops,** aka **Mu (μ) Boö,** at **15h 28m, +37° 02'**. At first glance, it's an unassuming, 4th-magnitude star, hovering a few degrees "above" Boötes' kite (see chart, page 6), but there's much more to it. Just to get started, a quick glance through your 'scope shows a 7th-magnitude companion, over 100" away; at the system's currently estimated distance of 110-120 light-years, that translates to an orbit of roughly 4,000 AU—about 100 times Pluto's distance from our Sun. According to Professor James Kaler, University of Illinois, the companion's orbit is wide enough to take 125,000 years or more to complete.

Visually, this wide pair is an easy split in any telescope: In my 6-inch Newtonian, they appear as a white or very pale cream primary and a dimmer white companion, with no trouble splitting them at just 30 power. (In my 12-inch Newtonian, the companion appears "topaz.") The primary is a class F star, hotter than our Sun; it has about twice our Sun's mass, and roughly 20 times its brightness. The companion though, has a secret—it's a very tight binary itself! If you have a night of steady seeing, high-power views reveal that this "star" is really a *pair* of sunlike stars (both of class G) in orbit around each other.

This duo is at least as snug-looking as the tighter of the Double-Double's (Epsilon [ε] Lyrae) pairs, and it's dimmer, too; so it's no wonder that it's challenging to split. In my 6-inch, a few weeks back, the companion's pair just *barely* split at 150x; it was more visible at 200x, but still fairly difficult. A very recent view in a lovely 8-inch, under good seeing, was a bit easier at about 150x; but the last time I tried with my 12-inch, *I couldn't split the companion at all*—atmospheric seeing will be critical, and if you don't succeed one night, try again.

When you *do* see them, you'll notice that companion's stars are lined up along the same line as the companion itself is from the main star, within a few degrees, making a striking trinary system. The dimmer of the companion pair is very similar to our own Sun in both appearance and its physical qualities, and the distance between it and the other companion star is 54 AUs, or about 30% more than the Pluto-Sun distance. Viewing this system, our "mighty" Sun's equivalent out there doesn't look very bright at all!

Here's one last idea for you to rattle around in the back of your head—Prof. Kaler and other sources also report that the main star is likely a binary, too—*that* companion was detected spectroscopically rather than seen. It has a period of around 300 days, and orbits fairly close to the primary—so Alkalurops would then be a *four*-star system, with the two outer stars orbiting each other and then, as a duo, going around the inner pair.

In a dark country sky, finding Alkalurops is easy—follow the southeast side of the kite from Arcturus to Izar (Eta [η] Boötis), and then to Delta (δ) Boötis, the "top-left" corner of the kite. (Izar and Delta Boö are both reasonably bright landmarks.) From there, look to Nekkar, or Beta (β) Boötis, the "top" of the kite—Nekkar and Delta are both of the same brightness. Now take a closer look at the sky between these two stars, and just "outside" of the kite, away from Arcturus and towards the constellation Hercules—you'll see a slightly dimmer star about 3° from the line between Nekkar and Delta—*that's Alkalurops*.

In the city, Nekkar and Delta *might* remain naked-eye visible on better nights, but Alkalurops will be washed out. You can still pick it up in your 'scope, though—center your Telrad on the line between Delta and Nekkar, and then slide it perpendicularly to that line and away from Boötes, until the trailing end of the Telrad's biggest circle rests on the Delta-Nekkar line. Alkalurops will be in your finderscope field.

Our second object**, Zeta Coronae Borealis,** or **Zeta (ζ) CrB** for short, is a lovely little binary—*ummm*, unless it's a trinary, or a four-star system! Located at **15h 40m, +36° 35'**, the star *looks* like a pretty little pair of mismatched white stars—they'd remind you of Castor (Alpha [α] Geminorum), except that here one is clearly "larger" than the other—I think the asymmetry aids the pair's aesthetics.

Zeta's *binary* nature is not in doubt—the two stars we see are definitely in orbit around each other. But as Prof. Kaler notes, there is disagreement over whether other data on this system truly demonstrates the presence of a spectroscopic companion (making the system a triple), or for that matter, *companions*, plural. And so, looking at the Zeta CrB system, along with its beautiful aesthetics, is a reminder of what astronomy, and science in general, really is—the *questioning* pursuit of knowledge, with things *remaining uncertain* unless or until better information is at hand. In Zeta's case, our best answer is that we just don't know, and that bit of mystery (at least for now) is part of what makes it interesting.

In my 6-inch, I got a tight but decisive split at 60 power, and I saw a beautiful pair of crisp white stars at 100x. At 150x, the pair were more obviously separated, but the view overall wasn't as enjoyable—as an experienced observer might expect, it was dimmer and blurrier and didn't really add anything. (Your results will differ, depending on your eyes, your gear, and sky conditions, so consider this just a starting point—try different powers to see what works best for you.) Historically, the dimmer star has been described as "smalt" (cobalt) blue—but modern references describe it as either white or very subtly tinted. In my 6-inch, the dimmer star occasionally displayed hints of a greenish hue.

Zeta CrB is a 5th-magnitude star, and thus visible without optical aid under dark country skies. Just glance about 3° eastward (towards the Hercules "keystone") from Alkalurops to the next noticeable star, and there it is.

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Astro Update

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that exploded. This is the first image ever made of a companion star that survived a supernova. The explosion was Type IIb, stripped-envelope. This means that the finally-imaged companion star likely gravitationally pulled the outside off the other star before the explosion. Some theoreticians claim that this type of supernova occurs because huge stellar winds strip the outer parts, but this observation supports the theory of stripping by companion star, at least in this case. Observations of more Type IIb supernovas are needed to support one or both of these stripping theories.

Martian Helicopter

NASA announced that a helicopter has been added to the next Mars rover (so far named only Mars 2020), so aerial views near the rover can be obtained. It weighs less than four pounds and has twin rotors that spin 10 times as fast as ordinary earthly craft, in order to fly in the thin Martian atmosphere.

Charon Names

The IAU has accepted a dozen names for features on Pluto's moon Charon that were suggested by the New Horizons spacecraft team. The names are from literature and mythology of exploration, and include Dorothy (of Oz), Clarke (author Arthur C. Clarke), Nemo (of *20,000 Leagues Under the Sea*) and Kubrick (director of *2001: A Space Odyssey*).

June Skies

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Under city skies, Zeta still makes a wonderful target, but light pollution will prevent you from just pointing directly at it. In that case, the easiest approach is still through Alkalurops. Center that star in your finderscope and have a look—in some finderscopes, like my 6x30, *Zeta is already in the field!* If it isn't, slewing gently eastward will bring Zeta in pretty quickly; a motion of a degree or so should cause it to slip into view. Because Alkalurops and Zeta CrB are so close, you only need to move *roughly* eastward; don't worry about maintaining great precision. (If you're using an equatorial mount, you've got it made—just give your Right Ascension control a twist until Zeta appears.)

One last quick note about Zeta CrB—the *main* star is actually "Zeta2," sometimes listed as Zeta^2 or ζ^2. The companion, somewhat counterintuitively, is "Zeta1"—some sky charts and software, including SkySafari, do use "ζ^2" to mark this star, so it's worth a mention.

—See you next month.

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