MARTIN RATCLIFFE and **ALISTER LING** describe the solar system's changing landscape as it appears in Earth's sky.

Visible to the naked eye
Visible with binoculars
Visible with a telescope

January 2019: Totality over America

The orange glow from all Earth's sunrises and sunsets painted the Moon during the September 28, 2015, total lunar eclipse. Observers across the Americas should get a similar view the night of January 20/21.

A total eclipse of the Moon is a highlight in a month that also features exceptional views of several planets. While the fainter worlds gather in the early evening sky, the more luminous ones congregate before dawn. Skywatchers should mark their calendars for the morning of the 22nd, when the two brightest planets, Venus and Jupiter, pass just 2° from each other.

Let's begin our tour of the night sky with its top event: the total lunar eclipse. Observers under a clear sky across North and South America can watch the Full Moon fade and change color as it slides through Earth's shadow the night of January 20/21.

The eclipse gets underway the evening of the 20th. Luna enters our planet's outer penumbral shadow at 9:37 P.M. EST. The penumbra's subtle shading initially has little effect on the Moon, but viewers should see the lower limb start to darken within a half-hour.

The partial eclipse officially begins at 10:34 P.M., when our satellite encounters Earth's inner umbral shadow. No direct sunlight enters the umbra, so you might expect the shadow to look black. And it does, at least at first. But as the Moon dives deeper into the shadow and totality approaches, it takes on a distinct orange glow. The color comes from all Earth's sunrises and sunsets — our planet's atmosphere bends this light into the shadow.

The color becomes even more noticeable during the 62 minutes of totality, which commences at 11:41 P.M. The eclipsed Moon is mesmerizing however you view it, but be sure to enjoy the surrounding sky. As the eclipse progresses, the sky darkens and the star-studded winter sky blossoms into view. Binoculars will reveal the attractive Beehive star cluster (M44) just 7° east of the Moon.

The total phase of the eclipse ends at 12:43 A.M., and the Moon exits the umbral shadow at 1:51 A.M. The final trace of the penumbra leaves the lunar disk without fanfare at 2:48 A.M. Don't pass up the opportunity to see this total lunar eclipse — you'll have to wait until May 2021 for the next one.

While the Moon glows orange only one evening this month, **Mars** shows a similar color every January night. The planet appears about halfway to the zenith in the southwest as darkness falls. It remains on view until it dips below the western horizon after 11 P.M. local time.

Mars stands out against the relatively dim background stars of Pisces the Fish. It shines at magnitude 0.3 in early January and fades to magnitude 0.9 by month's end, though that's still more than 10 times brighter than any of the constellation's stars.

The planet begins the month southeast of Pisces' Circlet asterism, a distinctive grouping that lies due south of the Great Square of Pegasus. The ruddy world then treks eastward rapidly. It slides 0.9° south of 4th-magnitude Epsilon (ε) Piscium on January 26.

Despite Mars' prominence to the naked eye, it doesn't offer much to observers with telescopes. The planet continues to move away from Earth and thus shrink in size. Its apparent diameter holds at 7" during the first half of January but drops to 6" by month's close. You'll need excellent viewing conditions to see it as anything more than a featureless disk.

Mars serves as a guide to finding Uranus and Neptune this month. The two conveniently bracket the Red Planet and glow brightly enough to show up through binoculars.

You'll want to hunt for **Neptune** first. It lies west of Mars and thus hangs lower in January's evening sky. The outer world lurks among the background stars of Aquarius, standing some 30° high at the end of twilight in early January. Its altitude drops by half at the end of the month, however, so don't put off your attempts to track it down.

The eclipsed Moon hangs just below the twin stars Castor and Pollux in Gemini at midtotality January 20/21.

Neptune lies midway between Lambda (λ) and Phi (φ) Aquarii, a pair of 4th-magnitude stars in eastern Aquarius. A trio of 5th- and 6th-magnitude stars — 81, 82, and 83 Aqr — form a right triangle in this area. But you'll need to hold your binoculars steady to spot the magnitude 7.9 planet among these stars.

Neptune lies 14' southeast of 81 Aqr on January 1. But the ice giant moves eastward and pulls away from 81. It ends the month 55' east of this star and 46' north of 83 Aqr.

A few other stars closer to Neptune's brightness populate this region, so it can be tricky to confirm a sighting. The best way is to target your suspected

— Continued on page 42

RISING MOON

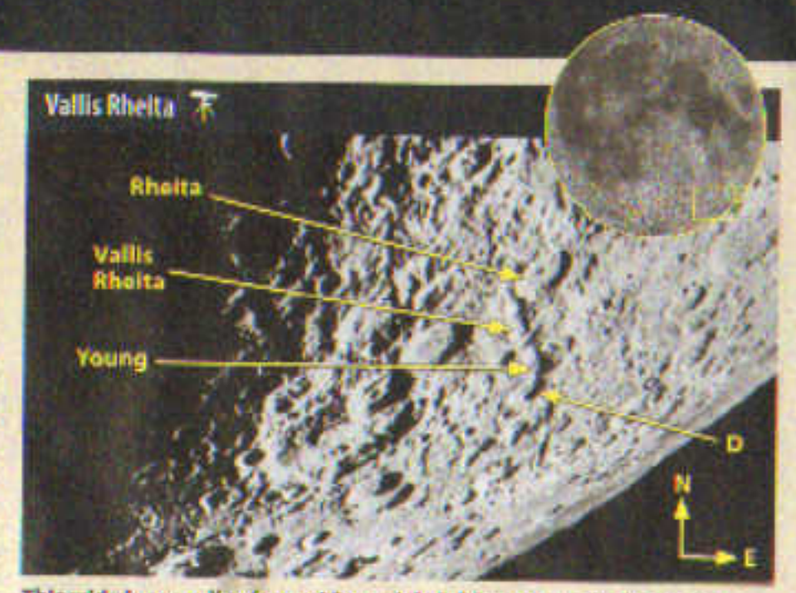
When second best is still fine

Only about a dozen major lunar valleys appear on the Moon's nearside. Most observers consider Vallis Alpes (Alpine Valley) in the north to be the best, but Vallis Rheita (Rheita Valley) in the southeast runs a close second.

The two are a study in contrasts. The Alpine Valley arose when the lunar crust pulled apart and the land collapsed. The Rheita Valley formed as a line of overlapping craters. The impacts occurred in rapid succession, with each new one obliterating the rim of the one right before it.

With a bit of practice and an eye for detail, you can tell that the Rheita Valley is neither the youngest nor oldest feature in the lunar southeast. Notice a couple of battered craters on the valley's northeastern flank. Their rims and floors appear worn down because they were pounded by later impacts, proving they formed earlier. Rheita Crater in the northeast and Young D at the south end clearly came later because they look sharper and obviously reshaped the underlying valley.

The Rheita Valley is the longest and widest valley on the nearside. But many similar crater chains surround large impact features. The chains form as debris from an impact shoots out in linear sprays like the spokes on a bicycle wheel. The Rheita Valley's size implies that the impact must have been big. It was: It blasted out Mare Nectaris (Sea of Nectar) to the north.



This wide lunar valley formed from debris blasted out by the impact that created Mare Nectaris.

Sunrise occurs over the Rheita Valley on January 8, but the image more closely matches what you'll see on the 9th. Take another look on the 22nd and 23rd, when the Sun sets over this region. The reversed lighting helps you see that the valley points right back to its origin in Mare Nectaris.

METEOR WATCH

Catch the year's best meteor shower

Streaks of light should pepper the night sky when the Quadrantid meteor shower peaks the night of January 3/4. With New Moon arriving just 48 hours later, dark skies prevail all night. None of this year's other major showers fares as well. As long as the weather cooperates, observers in rural areas should see a nice show.

Scientists expect the shower to peak around 9 P.M. EST. Sadly, the radiant — the point from which the meteors appear to originate — doesn't climb high until early morning. And rates drop dramatically from the peak. The Quadrantids can produce up to 120 meteors per hour at maximum, but that number drops to 30 just eight hours on either side. Although North American observers should see a good display, the best views likely will come from Europe.

A New Moon promises dark skies for the peak of 2019's most prolific meteor shower.

Quadrantid meteors
Active dates: Dec. 28–Jan. 12
Peak: January 3
Moon at peak: New Moon
Maximum rate at peak: 120 meteors/hour

The radiant lies in northern Boötes, an area once claimed by the now-defunct constellation Quadrans Muralis. That's where the shower gets its name.

OBSERVING HIGHLIGHT The Full Moon on January 20/21 slides deeply into Earth's shadow, bringing a total lunar eclipse to observers across the Americas.