A word from your editor by Sapavith ‘Ort’ Vanapruks

Covid-19 Notice
HAS have decided to cancel public HAS events for the time being, beginning with the March 14 public star party at Dillingham. Includes the upcoming in town star parties at Kahala and Geiger, as well as the monthly meeting. These cancellations will continue while we remain on lock down. We don't know yet what will happen with the club star party in June. We will try to update as soon as possible.

In June, we resumed the star party for club members only at Dillingham Airfield on Saturday, 6/20/2020. We are keeping members at 10 feet apart. Members are not to share their eyepieces for viewing.

While there were several members out at Dillingham Airfield on June 20, 2020, Tom Giguerre and I were watching an Annular Solar Eclipse 2020 travelling thru Asia from 7 P.M. to 11 P.M. HST. There were multiple feeds provided from many universities and organizations in the path of the eclipse. The 2 organizations that I watched were feed on YouTube by Slooh.com and Time-andDate.com. Tom was watching the feed by Al Sadeem Astronomy Observatory in Abu Dhabi. It was good to have someone to discuss this viewing throughout the whole thing.

We called Annular Solar Eclipse a ring of fire because the Moon is too far from Earth to cover the Sun so we could see the ring of the Sun around the shadow of the Moon. What made this 2020 Annular Solar Eclipse special is that it happened on summer solstice. You can read the article “A Solstice Solar Eclipse Is About To Happen: Just How Rare Is It?” by Ethan Siegel on page 4.

Inside this issue:

- Club Information 2
- President’s Message 2
- Observer’s Notebook 3
- Meeting Minutes 4
- Event Calendar 5
- NASA’s Night Sky Notes 7
- Meteor Log 8
- Treasurer’s Report 9

Upcoming Events:
- The next Board meeting is Sun., July 5th 3:30 PM. (Location TBD)
- The next meeting is on Tuesday, July 7th at the Bishop Museum at 7:30 PM.— CANCELLED
- Bishop Museum’s planetarium shows are every 1st Saturday of the month at 8:00 PM www.bishopmuseum.org/calendar
President’s Message
July 2020

SpaceX has successfully launched two astronauts to the International Space Station. This marks the first time that a private company has launched people into space and the first launch of astronauts from US territory since the Space Shuttle program ended in 2011. After nearly sixty years, private enterprise has joined governments as a provider of transportation of humans to space.

This is somewhat reminiscent of the relationship between amateur and professional astronomy. While professional astronomers have superior equipment, they must plan long in advance for their observing time. As amateur astronomers with our own equipment, we have the freedom to observe whatever we like whenever we want. Amateurs are often the first ones to detect changes in the atmospheres of Jupiter and Saturn, for example. We can quickly change plans when the occasion calls for it.

As we begin to loosen the COVID-19 restrictions on activities, we have received permission to conduct club-only star parties at Dillingham Air Field. Now that Jupiter and Saturn have returned to the evening sky, we once again have a good place from which to observe the changes in their atmospheres.

The number of new coronavirus cases has risen as restrictions have been loosened. Our overall number of cases in Hawaii has remained relatively low, but it seems unlikely that further loosening will be allowed until the number of new cases stabilizes once again. Until then, we have the opportunity to use Dillingham club-only star parties to use our own equipment to observe.

Stay safe, and continue keeping an eye on the sky. The big and bright planets are back! I look forward to the day when we can once again share views of them with the public.

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The Astronews is the monthly newsletter of the Hawaiian Astronomical Society. Some of the contents may be copyrighted. We request that authors and artists be given credit for their work. Contributions are welcome. Send them to the Editor via e-mail. The deadline is the 15th of each month. We are not responsible for unsolicited artwork.
Planets in July

Planets Close To the Moon
Times are Hawaii Standard Time

July 5, 13h, Moon 1.88° SE of Jupiter (171° from sun in midnight sky)
July 6, 00h, Moon 2.47° S of Saturn (165° from sun in morning sky)
July 10, 02h, Moon 4.1° SE of Neptune (117° from sun in morning sky)
July 11, 12h, Moon 1.81° SE of Mars (102° from sun in morning sky)
July 14, 05h, Moon 3.5° SE of Uranus (72° from sun in morning sky)
July 16, , 21h, Moon 3.1° N of Venus (42° from sun in morning sky)
July 18, 19h, Moon 3.9° N of Mercury (20° from sun in morning sky)

Planets Close To the Moon
Times are Hawaii Standard Time

Other Events of Interest
Times are Hawaii Standard Time

July 2, 21h. 532 Herculina at opposition
July 4, 03h, Earth at aphelion (1.0167 au from the sun)
July 4, 18:44h, Full Moon
July 8, 02h, Venus brightest, Mag. -4.48°
July 12, 04h, 2 Pallas at opposition
July 13, 22h, Jupiter at opposition
July 15, 02h, Pluto at opposition
July 20, 07:12h, New Moon
July 20,12h, Saturn at opposition
July 25 17h, Mercury at greatest elongation (20.1° West of the sun in morning sky)

Mercury
Will be visible low in the pre-dawn sky the last half of July.

Venus
Shines brightly in the pre-dawn sky, reaching maximum brightness of mag.-4.7 on July 8th.

Mars
Spends most of the month in Cetus. It is getting large enough to see some detail on its disk in good seeing with an angular diameter of 12.7”.

Jupiter
Reaches opposition on July 14, so is in the sky all night. Best observed near midnight with a magnitude of -2.8.

Saturn
Can be viewed about 8° east of Jupiter in the midnight sky in July. It reaches opposition on July 20 and shines at a magnitude of +0.1.

Uranus
Rises 2 hours before dawn and shines at magnitude +5.8 in Aries.

Neptune
Is in northwestern Aquarius and is easy to find with binoculars, shining at mag. +7.9.

2 Pallas
(Asteroid)
Reaches opposition on July 12 at magnitude +9.0

Pluto (Dwarf Planet)
Close to Jupiter in the midnight sky, reaching opposition on July 15.
A Solstice Solar Eclipse Is About To Happen: Just How Rare Is It?
Ethan Siegel, Senior Contributor, Starts With A Bang Contributor Group
Science (Publish in Forbes on June 18, 2020)

The Universe is out there, waiting for you to discover it.

On Saturday, June 20, 2020, the solstice will occur as the Earth’s north pole reaches its maximum tilt towards the Sun. Just 9 hours later, the Moon will pass perfectly between the Earth and the Sun, creating an annular solar eclipse for a myriad of observers across Africa and Asia. It’s an incredibly rare occurrence to have a solstice solar eclipse, but there’s a good reason for it this year. Here’s the scientific story of why.

The path of annularity extends from Africa through Asia for the eclipse of June 21, 2020. It passes through the cities of Rumbek and Waat in South Sudan, Sana’a in Yemen, Sukkur in Pakistan, and Xiamen in China, among others.© TIME AND DATE AS 1995–2020

The solstices happen twice a year, and the Moon cycles through its full set of phases every 29.53 days. In order to get a solar eclipse, the Moon needs to be in its “new” phase: the phase that it only achieves when the Moon passes between the Earth and the Sun. Getting a new Moon to coincide with the solstice isn’t so rare: about 3.4% of all solstices will have a new Moon occurring within 12 hours of that moment of maximal tilt. That’s true for any specific phase you care to examine.

3.4% of solstices will coincide with a first-quarter Moon.
3.4% of solstices will coincide with a full Moon.
3.4% of solstices will coincide with a last-quarter Moon.
And given that we have two solstices a year, this means that a whopping 13.5% of all years will either have a new Moon or a full Moon on one of the solstices.

That’s pretty frequent! Either a new Moon or a full Moon will happen on the solstice about every 7-to-8 years. We just missed a full Moon on the solstice in December of 2018, when that moment of 100% fullness occurred a little less than 24 hours after the moment of maximal tilt with respect to the Sun. Most recently, Earth experienced a full Moon occurring on the 2016 June solstice. Before that, Earth experienced a full Moon on the 2010 December solstice.

But for new Moons? We came close to having new Moons on the solstice in 2014 and 2006, but each time we were offset by approximately 24 hours instead of 12 hours. You have to go all the way back to 2001 to find a new Moon that coincided with the solstice, which it did on June 21 of that year. And quite remarkably, that solstice new Moon in 2001 also corresponded to a total solar eclipse.

Photographed from many locations in Africa, the last solstice solar eclipse occurred on June 21, 2001, and was a total solar eclipse. There was a prior solstice solar eclipse in 1982, and there will be solstice solar eclipses again in 2020, 2039, and 2058. (Francois LOCHON/Gamma-Rapho via Getty Images)

That’s a remarkable feat, and something that might come as a surprise. The solar eclipse occurring on the June solstice of this year, 2020, occurs precisely 19 years after the last solar eclipse on a solstice: June 21, 2001.

You might wonder if there’s a pattern at play, so it might occur to you to go look forward and backward in time in 19 year jumps. Sure enough, there was another solar eclipse on June 21, 1982. There will be another solar eclipse on June 21, 2039. And jumping ahead by another 19 years, there’s still another solstice solar eclipse in our future on June 21, 2058.

(Continued on page 6)
## Hawaiian Astronomical Society Event Calendar

### Upcoming Star Parties

<<Upcoming Star Parties>>

**Public Party Geiger/Kahala July 25—CANCELLED**

**Public Party Dillingham July 11—CANCELLED**

**Club Party-Dillingham July 18—TBD**

### Upcoming School Star Parties

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Volume 70, Issue 7

Page 5
But this doesn’t match what you might naively expect. A solstice solar eclipse every 19 years is too good to be true; it’s something that we shouldn’t expect to see. Here’s why.

In order to have a solar eclipse, you don’t just need a new Moon; you need a new Moon to occur precisely when the Moon crosses the Earth-Sun plane. The Earth traces an elliptical path around the Sun, and the Moon makes an elliptical orbit around the Earth, but those two ellipses are tilted with respect to one another. It isn’t much of a tilt — just 5.2° — but the Sun and the Moon are small enough as seen from Earth that most new Moons don’t result in any sort of eclipse at all. With the Sun and Moon each making a circle about 0.5° in diameter on the sky, only about one in five or six new Moons results in either a partial, annular, or total eclipse of the Sun. In the 20th century, for example, there were a total of 1,237 new Moons and a total of 228 solar eclipses: about 18% of all new Moons.

Eclipses only occur when the nodes of the Moon’s orbit, where it crosses the Earth-Sun plane, line up with a new or full phase. This is completely different from where apogee and perigee are.

For every 19 years that pass, we experience almost 235 lunar months: we fall short nearly 2500 years ago. For every 19 years that pass, almost exactly 235 lunar months (full cycles, from new Moon to new Moon) pass as well, meaning that eclipses recur in a 19 year periodic cycle. Well, almost.

For every 19 years that pass, we experience almost 235 lunar months: we fall short by mere 72 minutes. When we do get an eclipse on the solstice, we tend to get a number of them in a row with this 19 year pattern. But then, when enough of those “72 minutes” add up, they push us out of sync with the solstice once again.

So why, then, are we getting them once every 19 years? Why did we have one on the June solstice in 1982 and 2001; why are we having one in 2020; why will we have one in 2039 and again in 2058?

Eclipses only occur when the nodes of the Moon’s orbit, where it crosses the Earth-Sun plane, line up with a new or full phase. This is completely different from where apogee and perigee are. The total inclination of the Moon’s orbit, of 5.1°, represents the maximum possible variance from a perfect Moon-Earth-Sun alignment.

So what should this mean for solar eclipses on the solstice? If we take into account that:

- a new Moon occurs every 29.53 days,
- there are two solstices each year,
- 3.4% of all solstices will experience a new Moon,
- and that ~18% of all new Moons will result in a solar eclipse,

we can run the math and determine that, on average, a solar eclipse should occur on a solstice just once every 82 years. So why, then, are we getting them once every 19 years? Why did we have one on the June solstice in 1982 and 2001; why are we having one in 2020; why will we have one in 2039 and again in 2058?

It’s because, like everything involving the motion of bodies in our Solar System, events like these come in cycles. This particular phenomenon of a 19 year eclipse cycle is known as a Metonic cycle, dating all the way back to Meton of Athens nearly 2500 years ago. For every 19 years that pass, almost exactly 235 lunar months (full cycles, from new Moon to new Moon) pass as well, meaning that eclipses recur in a 19 year periodic cycle.

Well, almost.

For every 19 years that pass, we experience almost 235 lunar months: we fall short by a mere 72 minutes. When we do get an eclipse on the solstice, we tend to get a number of them in a row with this 19 year period. But then, when enough of those “72 minutes” add up, they push us out of sync with the solstice once again.

An illustration of the Sun-Moon-Earth conﬁguration setting up a total solar eclipse. When the Moon’s shadow falls on Earth when the nearer-to-the-Sun node aligns, we get a solar eclipse, only visible across a narrow band of Earth’s surface. However, the nodes of the Moon’s orbit around the Earth don’t match up perfectly with the calendar year on 19 year timescales, and this plays a vital role in predicting solstice solar eclipses.

We’re actually very lucky to be alive right now, when we’re experiencing a period where five solstice eclipses happen all in a row. There wasn’t one, however, on the June solstice in 1963. Nor will there be one on the June solstice in 2077. The eclipse cycles drift ever so slightly relative to our annual calendar over time, and this pulls events in and out of this 19 year pattern.

If you want to know when the last solstice solar eclipse was prior to 1982, you have to extrapolate all the way back to the December 22, 1870 total solar eclipse. If you want to know when the next one will be after the 2058 solstice solar eclipse, you need to jump forward all the way to the partial solar eclipse of December 22, 2242. There will be no solar eclipses on any solstice for almost 200 years once 2058 passes us by.
NASA’s latest Mars rover, Perseverance, is launching later this month! This amazing robot explorer will scout the surface of Mars for possible signs of ancient life and collect soil samples for return to Earth by future missions. It will even carry the first off-planet helicopter: Integrity. Not coincidentally, Perseverance will be on its way to the red planet just as Mars dramatically increases in brightness and visibility to eager stargazers as our planets race towards their closest approach in October of this year.

Perseverance’s engineers built upon the success of its engineering cousin, Curiosity, and its design features many unique upgrades for a new science mission! In February of 2021, Perseverance will land at the site of an ancient river delta inside of Jezero Crater and ready its suite of seven primary scientific instruments. The rover will search for traces of past life, including possible Martian fossils, with WATSON and SHERLOC, two advanced cameras capable of seeing tiny details. The rover also carries an amazing instrument, SuperCam, to blast rocks and soil outside of the rover’s reach with lasers to determine their chemical makeup with its onboard suite of cameras and spectrometers. Perseverance will also take core samples of some of the most promising rocks and soil, storing them for later study with its unique caching system. Future missions will retrieve these samples from the rover and return them for detailed study by scientists on Earth. Perseverance also carries two microphones so we can hear the sounds of Mars and the noises of its instruments at work. It will even launch a small helicopter - Ingenuity - into the Martian atmosphere as a trial for future aerial exploration!

Would you like to contribute to Mars mission science? You can help NASA’s rover drivers safely navigate the Martian surface by contributing to the AI4Mars project! Use this tool to label terrain features on photos taken of the Martian surface by NASA missions to help train an artificial intelligence algorithm to better read their surrounding landscape: bit.ly/AI4Mars

The launch of Mars Perseverance is, as of this writing, scheduled for July 20, 2020 at 9:15am EDT. More details, updates, and livestreams of the event are available on NASA’s official launch page: bit.ly/Mars2020Launch . Dig deep into the science of the Mars 2020 mission and the Perseverance rover at: mars.nasa.gov/mars2020/ . Find out even more about past, present, and future Mars missions at nasa.gov.

(Continued on page 10)
Strange Meteors: Have you ever seen a meteor and then second guessed yourself? “Was that really a meteor that I saw?” Since the duration of a small meteor may be just tenths of a second, they can play tricks with your vision and mind. Other internal factors can alter one’s perception such as floaters in the eye, or even missing the start of the meteor and observing the end as it fizzles.

Let’s look at external factors that can create meteors that may not be the real deal. This tale was inspired by Ort and his daughter Selena’s outing on June 16th. He sent me a picture of an unusual curved meteor that he captured from Campbell Industrial park, SW Oahu. The image also showed Sagittarius and Scorpius nicely, along with the planets Jupiter and Saturn. Curved meteors are unusual, so I was suspicious…also in the field of view is a large light house. We may never know for sure, but I suspect this “meteor” was a flying object that was illuminated by the light house beam during the time exposure. Selena did confess to seeing moths earlier in the evening.

Other unusual meteors have been reported in the past. A Sky and Telescope article described Baldet’s 1903 report of nebulous meteor that changed shape over the course of two seconds (https://astronomy.com/magazine/stephen-omeara/2019/04/whats-that-odd-meteor).

Rocket launch exhaust can generate a trail, however, an official from the California Academy of Sciences postulated that the strange light that glowed across California in December 2018 was likely a meteor (Joe Vasquez reports, 12-19-2018).

(Continued on page 11)

Phases of the Moon (courtesy timeanddate.com)

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<tr>
<th>Shower</th>
<th>Activity</th>
<th>Maximum</th>
<th>Radiant</th>
<th>$V_m$</th>
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<td>Jul 15-Aug 10</td>
<td>Jul 27</td>
<td>125°</td>
<td>341°</td>
<td>-30°</td>
<td>35</td>
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<td>South. $\delta$-Aquariids (005 SDA)</td>
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<td>Jul 29</td>
<td>127°</td>
<td>340°</td>
<td>-16°</td>
<td>41</td>
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<tr>
<td>$\alpha$-Capricornids (001 CAP)</td>
<td>Jul 03-Aug 15</td>
<td>Jul 29</td>
<td>127°</td>
<td>307°</td>
<td>-10°</td>
<td>23</td>
</tr>
</tbody>
</table>

If you report a cool meteor to the AMS or IMO, make sure that it’s not a moth first! For more info contact: Tom Giguere, 808-782-1408, Tom.Giguere@yahoo.com; Mike Morrow, PO Box 6692, Ocean View, HI 96737.
I have spent an hour on the phone with American Savings tech support. I am currently unable to download or view bank statements from the Web site. A tech did e-mail a PDF copy of the statement ending June 9, and there wasn’t any activity. My own records show a fair amount after June 10. So...

Thanks to everyone who joined, and/or renewed. I have also caught up with all magazine requests, filed a form 990 with the IRS, updated our roster with the Astronomical League along with paying the yearly membership, and used up all the checks that April (the last treasurer) gave me when I took over. We have a shiny stash of new, print through, business checks to continue on.

HAS received permission to resume its monthly members only star parties at Dillingham (Kawaihapai) Airfield. In spite of unfavorable forecasts quite a number of people showed up. They were mostly Dob owners. Indeed, mine was the only scope that wasn’t a Dob.

The weather, as forecast, wasn’t that great, but the clear areas were exceptionally clear. My own 7” Maksutov easily showed structure in M101, plus some of the best views I have had of globular clusters. This was true of everyone. When the low power views were good, they were very good.

In short, lots of comments of how good it was to be back outside, and seeing old friends (in the sky). We eventually left at 11:00 p.m. as the clouds rolled in, yet again.

Wishing everyone the best, and stay safe.
Observe Mars yourself over the next few months! Mars can be found in early morning skies throughout July, and by the end of the month will rise before midnight. Mars gradually brightens every night until the close approach of Mars in October. The pre-dawn skies of July 17 present an especially nice view, as the waning crescent Moon will appear near Venus and Aldebaran.

Screen capture of the Annular Solar Eclipse during Max Eclipse fed by timeanddate.com. The footage was provided by Neelam & Ajay Talwar from Sirsa, Haryana, India.
Artistic photographer, Rikki Hibbert (Rivonia, Johannesburg, South Africa) deliberately targeted moths, not meteors in her time exposure. My most difficult Perseid meteor observing session occurred during an Alabama summer where the fireflies were abundant—as I watched the sky the fireflies constantly caught my vision with their intermittent light flickering on and off!

**Meteor Shower Preview:** The South Delta Aquariids is a strong shower best seen from the southern tropics, but still well placed for Hawaii observers. This shower produces good rates for a week centered on the night of maximum. The shower produces usually faint meteors that lack both persistent trains and fireballs. The parent object is tentatively identified as 96P/Machholz. The Moon will be 66% illuminated.

(Continued from page 6) On December 22, 1870, a total solar eclipse occurred on the December solstice. This would be the last solstice solar eclipse to occur on Earth until 1982, and the last December solstice solar eclipse for more than 300 years: until 2242 rolls around.

UNITED STATES NAVAL OBSERVATORY

Why don’t the eclipses simply gradually shift, then? Why do they fall completely out of phase with our annual calendar? It’s because the nodes of the Moon’s orbit — the places where the Moon crosses the Earth/Sun plane — occur with a slightly different frequency than the phases of the Moon. The Moon crosses through each node in its orbit with a frequency of 27.22 days, rather than the 29.53 days that the lunar phase cycle recurs on.

But here’s the kicker: when we extrapolate this all the way out to 19 year periods, both the lunar phase cycle and the node-crossing cycle almost perfectly align. 19 calendar years is the same as 235 lunar phase cycles (minus 72 minutes), but it’s also the same as 255 node-crossing cycles, which are known as draconic months. Only, the node-crossing cycles miss this 19 year periodicity by about 12 hours. On Earth, after 4 or 5 eclipse cycles, these cycles fall out of phase by enough that eclipses no longer recur at the same time of year.

A solar eclipse occurring coincident with the solstice is a pretty rare event, but one that we’re fortunate enough to be experiencing quite regularly at the present. Over a very long timescale, we’ll only see one solstice solar eclipse every 82 years or so: not very good odds for a human. But because of how these events cluster together in 19 year intervals, we had one in 1982, 2001, and one having one in 2020, and will have more in 2039 and 2058. All of these will occur on the June solstice.

And then, there will be an enormous drought. For 184 years after the 2058 event, planet Earth won’t experience another solstice solar eclipse. After an incredible drought, the December 22, 2242 solstice will finally see them return with a partial solar eclipse. There will be a cluster of a few in a row every 19 years after that, and then another drought until 2373, when a total solar eclipse occurs on the June solstice.

Enjoy the 19-year return of June’s solstice solar eclipse while you can. Once 2058 passes us by, they won’t be back for nearly two full centuries.

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Ethan Siegel
I am a Ph.D. astrophysicist, author, and science communicator, who professes physics and astronomy at various colleges. I have won numerous awards for science writing since 2008 for my blog, Starts With A Bang, including the award for best science blog by the Institute of Physics. My two books, Treknology: The Science of Star Trek from Tricorders to Warp Drive, Beyond the Galaxy: How humanity looked beyond our Milky Way and discovered the entire Universe, are available for purchase at Amazon. Follow me on Twitter @startswithabang.

(Continued from page 8) **Meteor Log by Tom Giguere**

Artistic photographer, Rikki Hibbert (Rivonia, Johannesburg, South Africa) deliberately targeted moths, not meteors in her time exposure. My most difficult Perseid meteor observing session occurred during an Alabama summer where the fireflies were abundant—as I watched the sky the fireflies constantly caught my vision with their intermittent light flickering on and off!

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The solar eclipse shadows a portion of Asia on June 21, 2020, as the International Space Station orbited over Kazakhstan and into China. In the foreground, is the H-II Transfer Vehicle-9 from JAXA, the Japan Aerospace Exploration Agency. Image Credit: NASA.