JANUS

THE NEWSLETTER OF EWELL ASTRONOMICAL SOCIETY

February 2021 EDITION

Editor: ewellastro.editor@gmail.com
Email: ewellastro@gmail.com
Website: https://www.ewellastronomy.org

Editorial

Welcome to the February edition of Janus. It's slimmer than the last 2 or 3 issues, mainly due to a lack of observation notes. This is, sadly, an inevitable consequence of the shortage of good viewing conditions.

Talking of viewing conditions, Ron Johnson has provided a summary of the conditions for 2020 which is included in this month's issue. Doubtless folk will want to read it for themselves but, suffice to say that, after a very promising start in which April and May were particularly good, and the percentage of usable nights in the first six month reached 47%, the year went downhill. We eventually ended up with only 39% of nights being usable for observations which is about par for the course I suspect.

There is still no indication as to when the current lockdown might be eased, much less abolished. Hence, physical meetings and group observing sessions continue to be precluded for the foreseeable future.

As Stephen reports later, we had another successful virtual meeting in January, and both the February and March meetings will also be virtual.

Due to a shortage of other contributions, I have been forced to produce a piece of my own! It's an update on the status of the Starlink constellation of satellites which have attracted criticism due to the adverse effect they have had on astronomical observations. I trust you will find it interesting.

Finally, don't forget the Society's social media sites, which are always worth a look.

John

SkyUpdate
What's up this month?

The Solar System February

MERCURY: begins the month having recently passed greatest elongation E. It is, however, not observable, reaching its highest point in the sky during daytime and is no higher than 4° above the horizon at dusk. By the end of the month, emerging into the morning sky approaching greatest elongation W, it remains not observable. It will reach its highest point in the sky during daytime and is no higher than 1° above the horizon at dawn.

VENUS: will soon pass behind the Sun. At the beginning of the month, it is not observable, reaching its highest point in the sky during daytime and is 0° below the horizon at dawn. By the end of the month, it is still not readily observable since it is very close to the Sun, at a separation of only 6° from it.

MARS: is currently an early evening object. It begins the month visible in the evening sky, becoming accessible around 17:29 UT as the dusk sky fades, 55° above the S horizon. It will then reach its highest point in the sky at 17:50, 55° above the S horizon, and continue to be observable until around 00:08, when it sinks below 10° above the W horizon. By the end of the month, it is receding into evening twilight, becoming visible around 18:21 as the dusk sky fades, 56° above the SW horizon. It will then sink towards the horizon, before setting at 01:08.

JUPITER: recently passed behind the Sun at solar conjunction. At the beginning of the month, it is not readily observable since it is very close to the Sun, at a separation of only 2° from it. By the end of the month, it is not observable – it will reach its highest point in the sky during daytime and is no higher than 1° above the horizon at dawn.

SATURN: also recently passed behind the Sun at solar conjunction. At the beginning of the month, it is not readily observable since it is very close to the Sun, at a separation of

only 7° from it, and is no higher than 6° above the horizon at dusk. By the end of the month, it is not observable, reaching its highest point in the sky during daytime and is no higher than 1° above the horizon at dawn.

URANUS: begins the month as an early evening object, receding into evening twilight. It becomes visible from around 18:10 UT as the dusk sky fades, 51° above the S horizon, and will then sink towards the horizon, setting at 00:47. By the end of the month, it will become visible around 18:54 UT as the dusk sky fades, 36° above the SW horizon. It will then sink towards the horizon, setting at 23:01.

NEPTUNE: will soon pass behind the Sun at solar conjunction. Early in the month, it is not observable – it will reach its highest point in the sky during daytime and is no higher than 17° above the horizon at dusk. By the end of the month, it is not readily observable since it is very close to the Sun, at a separation of only 10° from it.

MOON PHASES:

Full Moon	28 January
Last Quarter	4 February
New Moon	11 February
First Quarter	19 February
Full Moon	27 February

Notable Events:

Observation of many of these events will require a large telescope, although some will be visible with the naked eye. More information at *https://in-the-sky.org*

2 Feb - Asteroid 18 Melpomene at opposition
18 Feb - Conjunction of the Moon and Mars
19 Feb - Close approach of the Moon and Mars
19 Feb - M81 is well placed
22 Feb - Asteroid 29 Amphitrite at opposition
24 Feb - Mercury reaches highest point in morning sky

Collected Observations (and thoughts) – Gary Walker

Mars now distant - 15 Jan 2021

I observed Mars on 15th January, and it was now quite small, even at 333X magnification. It was only 9' arcseconds in size, well down from its 22' arcseconds size at opposition, just over 3 months earlier.

I could see a dark feature upon Mars, which the Sky & Telescope Mars Profiler Tool showed to be Syrtis Major. However, as Mars was now so small, it meant that, unlike when it was near opposition, I could no longer see the proper shape of it.

At its furthest distance from Earth, Mars is only about 3.5' arcseconds in size, i.e. no “bigger” than Uranus.

Mars was still a little brighter than the star, Aldeberan.

Indeed, for most of its orbit, Mars remains small, and is lost for a long time in the Solar glare. Only gradually does it creep back into, first, the morning skies, before it eventually gets into the evening sky.

For this reason, I often don't see it for about a year!

Latest observations - 29 Jan 2021

On 29th January, I saw an unusual Prominence at the 11'oclock position at about 12:30 UT. It appeared like a fairly large propellor and had 3 “vanes”. However, by 14:19 UT, it had collapsed into a more compact triangular shape.

The main observation period of Mars is now over, as the angular size of it has shrunk down to only 8' arcseconds. Whilst I can still see dark features with my 8" SCT, I cannot really see the shapes of them anymore, not even when the familiar Syrtis Major was centrally placed on it on 15th January.

During a previous "season" of observation, I could just detect dark features when Mars was only 5.4' arcseconds in size.

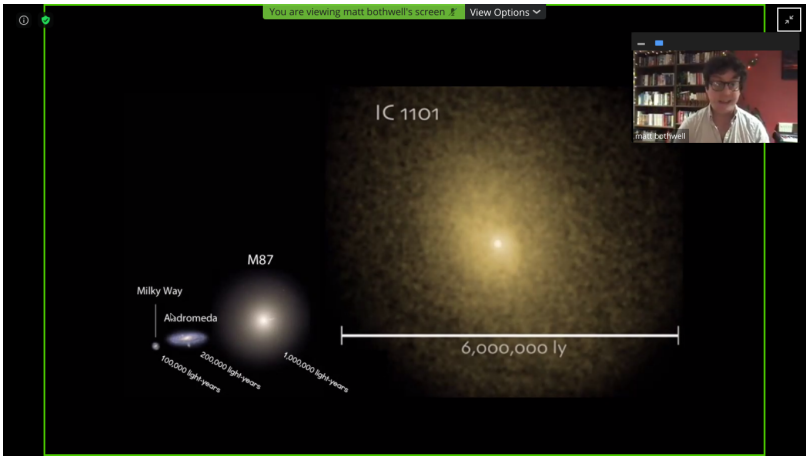
It used to be stated that Mars observations were only possible when Mars was at least 10' arcseconds in size, but recent books and magazines said that it can be done from 6' arcseconds, upwards. This is presumably due to the fact that amateurs now have access to much better imaging techniques, where images can be "stacked", in order to gain clear images. Indeed, the venerable Planetary Imager, Damien Peach, managed to image Mars, when it was only 4.3'

arcseconds, at the start of this present "cycle".

In any case, Mars spends most of its "life", at very small sizes, and can get down to as small as 3.5' arcseconds - scarcely any larger than Uranus ever gets to be!

In actual fact, it is not very often that Mars is even as "large" as 10' arcseconds. Added to that, is the fact, that for about a year, it is either lost in the solar glare, or only observable at unsociable hours, very low down in the dawn sky!

January Meeting Reports - Stephen



We were very fortunate to have Matt Bothwell of University of Cambridge at our January Zoom meeting, to talk to us about Massive Galaxies Hidden in the Early Universe.

In his fascinating talk, Matt introduced us to the giant “Red Dead” galaxies lurking in deep space, that until recently have been the most distant and oldest galaxies that we have been able to see, and which he described as “cosmic dinosaur fossils”. These ancient galaxies have not formed stars for billions of years.

Invisible to us at optical wavelengths, but visible instead at sub-millimetre wavelengths, a new generation of galaxies has now been discovered due to the advent of sub-millimetre telescope technology. These ancient galaxies are forming stars at a staggering rate, and don’t obey the distance/brightness rule because they are so far away that their redshift signature shines brightly at the submillimetre wavelength. When we observe these galaxies, we are looking back 11-12 billion years into the past - not long after the Big Bang (14 billion years).

These galaxies are enigmatic, and there is still a great deal that we don’t know about them, especially as our limited technology can currently only deliver low resolution images of them. But new technologies, such as the James Webb telescope and the Square Kilometre Array will give much improved resolution images, that should start to answer some of these questions during the next 10 years.

After the main talk, our very own Ron Canham delivered his Sky at Night presentation for the month to come, and then we enjoyed a short quiz, which has become a new feature of our monthly meetings. Thanks to Sue Stangroom for putting together the quiz using questions from a 1985 quiz that she has found in the EAS archives. There was much head-scratching and banter as members struggled to answer some really quite challenging questions.

The meeting was well attended, with 28 members signing-in, and it is pleasing to see that these Zoom meetings are becoming popular and are running much more smoothly as we all start getting to grips with the new way of doing things, in the “New World” that COVID has forced upon us.

Update on Starlink - John Davey

Space-X continues to deploy its Starlink satellites and, if anything, has increased its already significant launch rate.

2021 has seen further significant milestones in the programme. The launch of an additional 60 satellites on 20 January saw the number of satellites launched exceed 1000, with 950 still in orbit. Two further launches planned for 4 and 5 February will see the number launched rise to 1155.

In addition to routine launches of Starlink satellites into their "normal" 53.1° inclination, 360km altitude orbit, a further 10 Starlink satellites were launched and deployed into a different orbit as part of a record breaking smallsat "Rideshare" mission. This mission, launched on 24 January, broke the record for the most satellites launched on a single rocket. The Transporter-1 mission successfully launched 143 spacecraft into orbit, breaking the previous record held by Indian Space Research Organization's (ISRO) PSLV-C37 launch of 104 satellites in February 2017. Transporter-1 carried 133 commercial and government spacecraft set for Sun-Synchronous Orbit (SSO) launch, and 10 Starlink satellites — the first batch in the constellation to be deployed into a 97.5° inclination, 530 km altitude polar (Sun-synchronous) orbit.

The deployment of Starlink satellites into polar orbit required Space-X to get permission from the US FCC to vary its approved plans. Their request met with opposition from Amazon which claimed that placing satellites in an orbit between 540 km and 570 km with a 30 km buffer for error would overlap with Amazon's lowest approved shell for its Kuiper mission which is set at 590 km with a buffer of 9 km. Although Amazon has yet to deploy any of its Kuiper satellites, SpaceX agreed to tighten the orbital tolerances on the Starlink satellites at 570 km such that they would not fly higher than 580 km, thereby (narrowly) avoiding Kuiper satellites at 590 km. Despite such narrow margins in separation, and opposition from another commercial operator, Viasat, Space-X was granted permission by FCC to deploy a limited number of satellites into polar orbit.

A further difference between the 10 satellites in polar orbit and the other Starlink satellites is that they are equipped with laser intersatellite links. These links allow satellites to transfer communications from one satellite to another, either in the same orbital plane or an adjacent plane. Such links allow operators to minimize the number of ground stations, since a ground station no longer needs to be in the same satellite footprint as user terminals, thereby extending coverage to remote areas where ground stations are not available. They can also decrease latency, since the number of hops between satellites and ground stations is reduced, which is particularly important for polar regions.

The astronomical community continues to express concerns about the effects of large constellations of satellites such as Starlink on astronomical observations. In a previous article, I reported that one of the Starlink satellites launched on 7 Jan 2020 (Starlink-1130) had been coated so as reduce its reflectivity. Astronomers were asked to assess how much this coating appeared to reduce the satellite's reflectivity. Brightness measurements of Starlink (and other) satellites have been conducted but, until recently, there was no quantitative verification that a dark coating actually achieves the expected reflectivity reduction. However, a paper (which I am unable to access in full - I've only seen the abstract) published in *The Astrophysical Journal*, *Volume 905*, *Number 1* entitled "Simultaneous Multicolor Observations of Starlink's Darksat by the Murikabushi Telescope with MITSuME" compares the brightness of Starlink-1130 (Darksat) with an uncoated satellite from the same launch, Starlink-1113. The Murikabushi Telescope is part of the Ishigakijima Astronomical Observatory and can observe celestial objects simultaneously in three different wavelengths (colours). Comparing multi-colour data obtained under the same conditions provides more accurate insight into how much the coating can reduce the satellite brightness. The paper presents the magnitudes and associated colours for the two satellites as measured in the SDSS g-band (400-540 nm), SDSS r-band (540-680 nm) and SDSS i-band (680-820 nm).

Observations of the 2 satellites conducted from April to June 2020 reveal 5 major results:

1. The g-band apparent magnitudes of Darksat (6.95 ± 0.11–7.65 ± 0.11 mag) are comparable to or brighter than that of STARLINK-1113 (7.69 ± 0.16 mag)

2. The shorter the observed wavelength is, the fainter the satellite magnitudes tend to become.
3. The reflected flux by STARLINK-1113 is extremely (>1.0 mag) redder than that of Darksat
4. There is no clear correlation between the solar phase angle and orbital altitude-scaled magnitude.
5. By flux model fitting of the satellite trails with the blackbody radiation, it is found that the albedo of Darksat is about half that of STARLINK-1113

Whilst result 1 is inconsistent with previous studies, the overall conclusion is that artificial satellites, whether coated or not, are more visible at longer wavelengths, and that a dark coating, such as that applied to Starlink-1130, has the potential to halve the level of surface reflectivity of satellites.

Moves are also being made towards developing an ISO standard which would impose a number requirements on builders and operators of large satellite constellations including one to limit a satellite's brightness - Mag 7 has been floated as a limit - but there is a feeling that this will have to be balanced against any requirement to make the satellites trackable by optical sensors. Measurements such as those detailed above will clearly be essential to arriving at realistic limits on brightness.

2020 Night Sky Conditions – Ewell, Surrey - Ron Johnson

2020 was a year of two halves. During the first six months we had 36 clear nights and, if this had continued, we would have ended up with the highest number of clear nights in a year since 2003. Unfortunately, it did not, and we only had 13 clear nights during the second half of the year. Details of the monthly totals are given below.

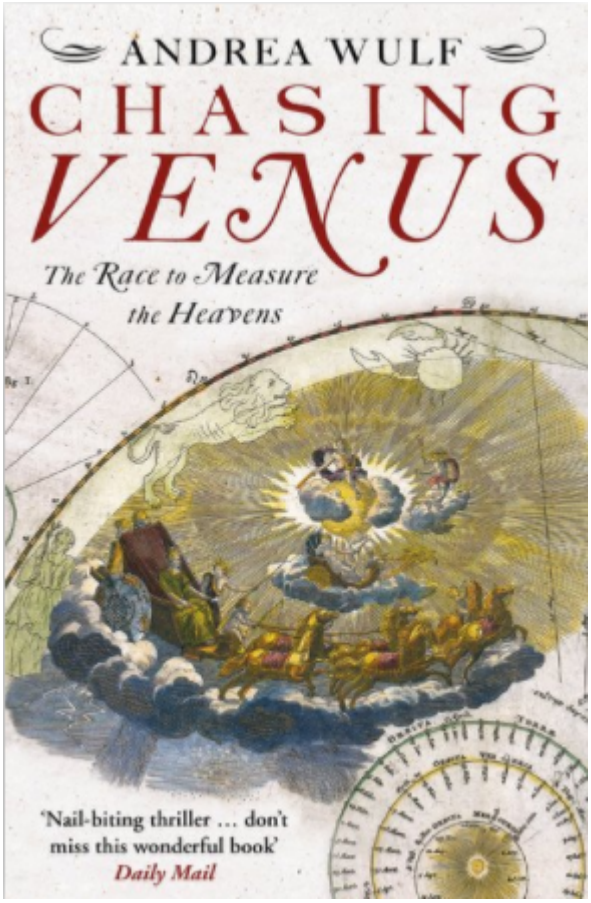
	Clear	Clear/Cloudy	Cloudy	% Usable
January	2	9	20	35.4
February	2	10	17	41.4
March	8	9	14	54.8
April	10	11	9	70.0
May	10	8	13	58.0
June	4	2	24	20.0
July	7	5	19	38.7
August	1	5	25	19.4
September	4	11	15	50.0
October	0	9	22	29.0
November	1	11	18	40.0
December	0	4	27	12.9
Totals	**49**	**94**	**223**	**39.1**

Definitions:

Clear Night: No cloud in the sky throughout the period. (Notionally dusk – 23.00UT)
Clear/Cloudy: Cloud passing from time to time with clear periods long enough to permit observations to be made.
Cloudy Night: Sky completely covered in cloud throughout the period.

Book Review - Chasing Venus *The Race to Measure the Heavens* by Andrea Wulf

The fascinating story of the world's first international scientific collaboration.



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Format: Paperback
Pages: 352

On two days in 1761 and 1769 hundreds of astronomers pointed their telescopes towards the skies to observe a rare astronomical event: the transit of Venus across the face of the sun.

This compelling read demonstrates that international, and indeed global collaboration in scientific endeavour is not a new thing. Wars and professional rivalries were put aside as astronomers united in a common goal, and travelled to the furthest reaches of the globe to measure the two transits of Venus from the optimal locations that would allow a parallax calculation to determine the distance from the Earth to the Sun.

As well as lots of great technical astronomy, this book is also an account of adventure on the high seas, and epic journeys across continents to reach far-flung and exotic places from which to view the transit at its best. The book encompasses political and scientific influences, the challenges of exploration, communication and navigation in the 18th Century, and a time-critical mission-based drama that would sit well within any modern thriller and makes it difficult to put down. It is an excellent companion to *Longitude* and *Sextant.*

*Andrea Wulf's story of the chase is **an enthralling, nail-biting thriller** and will undoubtedly prove one of the non-fiction books of the year. Even if you fail to see the Transit, **don't miss this wonderful book***
JOHN HARDING, DAILY MAIL

A fine example of scientific storytelling about astronomers of the Enlightenment observing the transit of Venus ... narrated with elegant expertise.
IAIN FINLAYSON, THE TIMES

Up Next:

NEXT MEETING: 8pm Friday 12 February 2021 - Virtual meeting via Zoom

Mike Leggett will talk about the search for Extra-terrestrial Intelligence.

Ron Canham will also deliver his Sky at Night presentation for the month to come.

NEXT USER GROUP:

Suspended until further notice.

NEXT DENBIES OBSERVING SESSION:

Suspended until further notice.

AD HOC OBSERVING AT WARREN FARM:

Suspended until further notice.