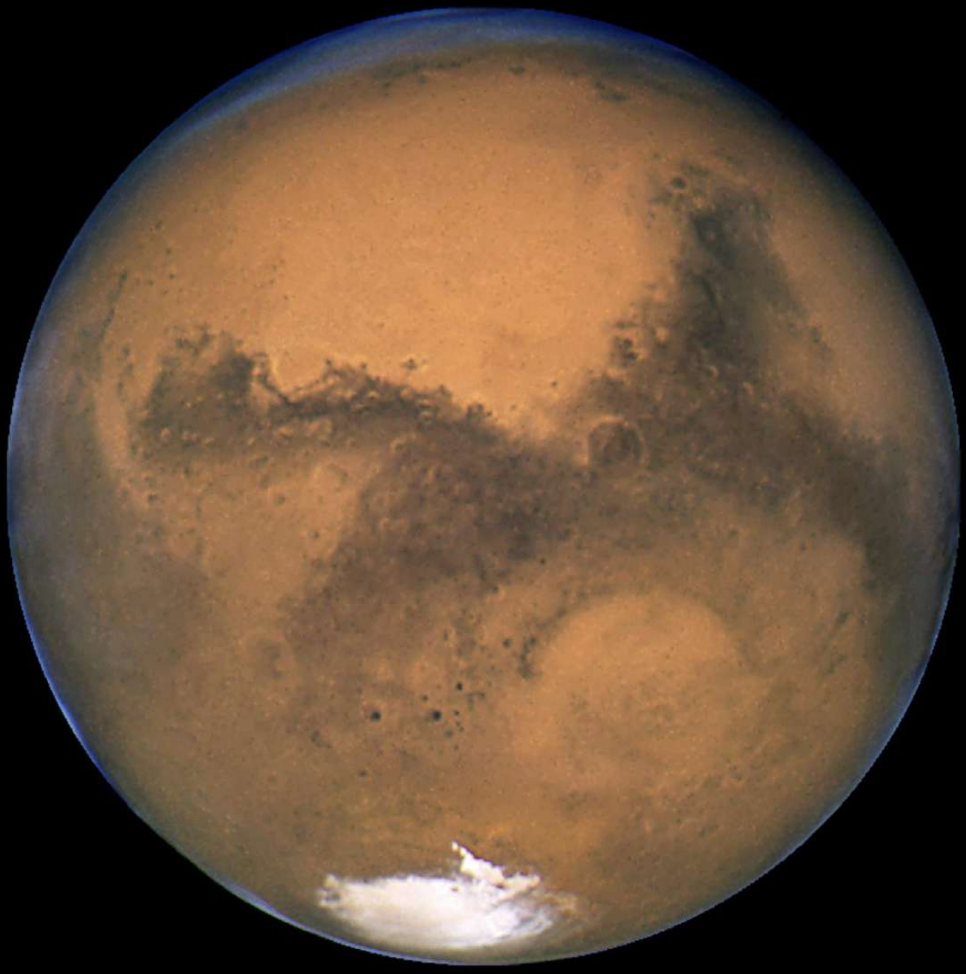
Prime Meridian (158) July 20, 2022

Can humanity escape to Mars?

Could a new home on another world give us a way out of the Earth Crisis?

Could a colony on Mars enable us to avoid our extinction and ensure that our species survives into the far future?

It's time to look at the reality versus fantasy.



August 23, 2003. NASA, ESA, and The Hubble Heritage Team (STScI/AURA)

We look also at some of the views of the night sky from February to May 2022.

It doesn't matter how fast or how far we can run, we cannot escape from ourselves . . . even in space.

Editor Martin Heath

We hear talk about how our species could escape catastrophes on Earth, including collisions with asteroids or comets, by occupying other planets. An obvious choice is Mars, the most Earth-like planet, although small, cold and oceanless. The reality of the Earth Crisis, caused by human behaviour, in many cases by focussing on short-term or selfish gain, raises questions about our credentials as planetary home makers. We are destroying the natural life support systems, provided free of charge, upon which we depend. At the same time, we are threatened by conflict among ourselves, and advances in weapons continue. Were we to occupy another world, there is a danger that we would enlarge the theatre of crisis.

Below: The reality of space and the hope of space. In the early morning of July 5, 2022, the International Space Station slid by Mars. Photo from Ash, Kent. Modified chart from *Stellarium*.

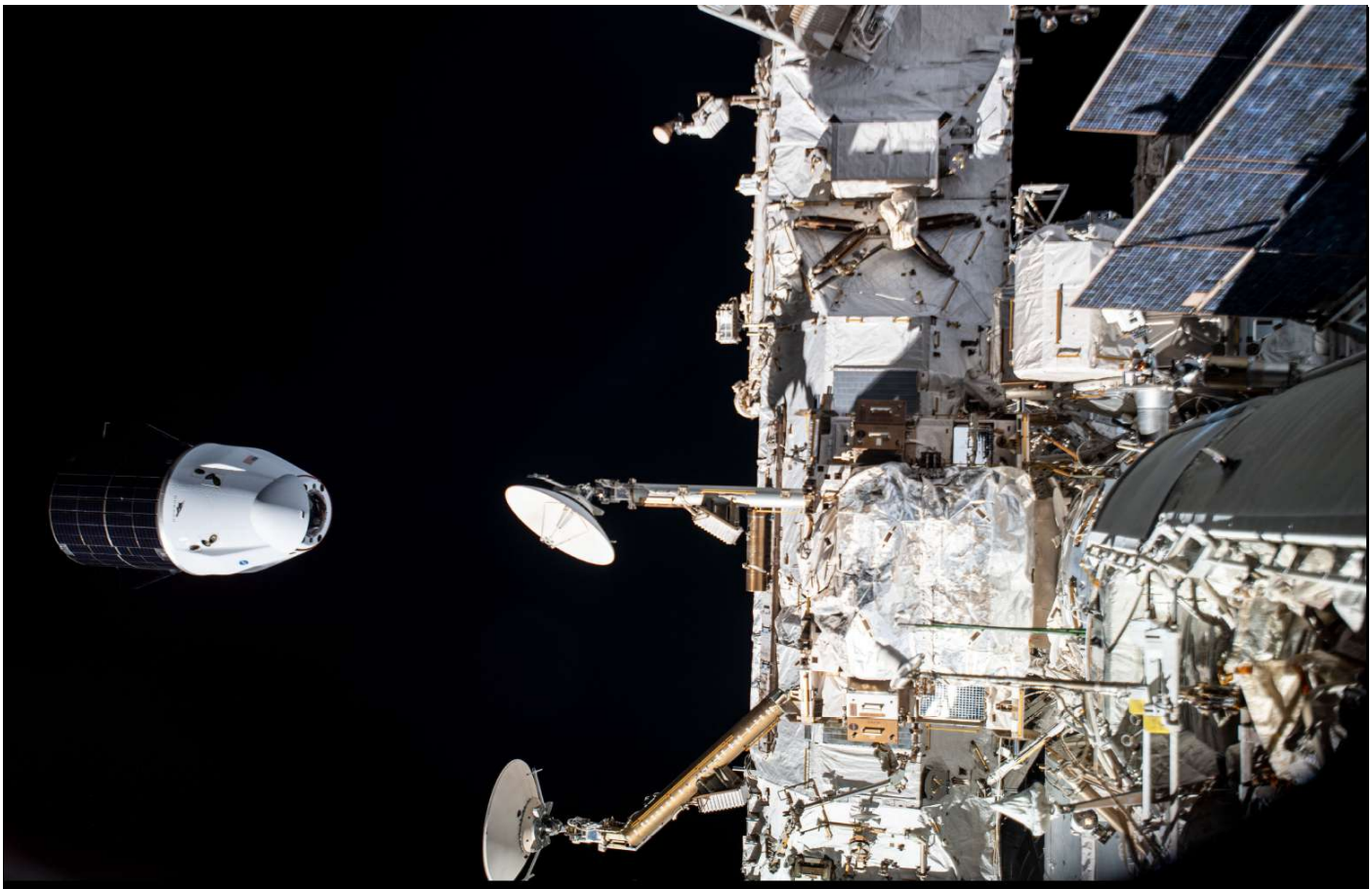
SPACEX images.

The first steps in the human journey towards Mars have begun.

Launched on Sept. 16 and splashdown on Sept. 18, 2021, a space craft from Elon Musk's SPACEX, was not merely an exercise in space tourism. The Inspiration 4 craft did not just carry people to peer out for a moment into the edge of space. It put four people in orbit at 585 km above the surface, higher than the International Space Station. This was the first test of a transport system intended eventually to ferry people to Mars colonies. SPACEX's explicit rationale is that the survival of *Homo sapiens* would no longer depend on Earth alone.

It is time to face challenging questions about a human future on Mars.

A view taken by NASA's Perseverance Mars rover of "Santa Cruz" hill 2.5 km away within Jezero Crater on Mars. April 29, 2021.



Above: SpaceX Dragon capsule departs from the International Space Station on July 8, 2021.

Reaching the Moon and Mars – the technology is arriving fast.

Elon Musk's SpaceX company has the explicit and bold intention of "MAKING LIFE MULTIPLANETARY." That would be a major turning point in the history of life. https://www.spacex.com/media/making_life_multiplanetary_transcript_2017.pdf

SpaceX takes us beyond space toys for the rich and into a very different realm. It has a determined prospectus to change history. It is presently carrying cargo and crew between the Earth and the international space station, and has done so since May 2020. So far, it has carried 4 crew, but could carry more. According to SpaceX:

"The Dragon spacecraft is capable of carrying up to 7 passengers to and from Earth orbit, and beyond. It is the only spacecraft currently flying that is capable of returning significant amounts of cargo to Earth, and is the first private spacecraft to take humans to the space station." https://www.spacex.com/vehicles/dragon/

Questions have been raised about why NASA chose Musk's company to go to the Moon, rather than Bezos' Blue Origin or Dynetics of Huntsville. Complaints were dismissed. A piece in *The Guardian* outlined the clash: "Space agency breaks with tradition by awarding $2.9bn contract to single company in 'big step' for moon-to-Mars strategy . . . further strengthening Elon Musk's grip on the burgeoning public-private space industry. . . . Musk's company is currently the only operation with the capability of launching astronauts from US soil. But Nasa's decision to go with a sole contractor for its human landing system (HLS) raised eyebrows."

Richard Luscombe https://www.theguardian.com/science/2021/apr/17/nasa-spacex-moon-spacecraft-elon-musk

Musk has indicated that he is creating a *transport system*, not buildings or any other aspects of colonisation. It is now time, however, to open a serious debate about the implications of colonising Mars.

Above: A SpaceX illustration of a future Mars colony.

Forty years, that is half-a-life-time from now, some of our readers might, if Musk is correct, witness meaningful colonisation of Mars.

Some facts about Mars; a distant, intensely cold planet where humans could not survive outside of an artificial environment. At the same time, Mars can be sufficiently Earth-like to be beguiling. Mars is much smaller than the Earth, just 53% of its diameter and 10.7% of its mass. Gravity on Mars is a mere 0.38% that on Earth. It is much less geologically active and ancient craters and great impact basins have survived from the early days of the Solar System. An Astronomical Unit (AU) is the mean distance of the Earth from the Sun, namely 149,597,870.700 km. Mars follows a much more eccentric orbit than the Earth, coming as close to the Sun as 1.382 AU and outward to 1.666 AU. The Martian day is 24 hours 39m 36s solar day compared with 24 hours on Earth and has an axial tilt of 25.19° compared to 23.44° that of the Earth. The atmospheric pressure is equivalent to 0.00628 Earth atmospheres, and composed of nearly 96% carbon dioxide. The average temperature of Mars is -63°C and its coldest temperature can be a deadly -143°C. Occasionally, temperatures can be much warmer. NASA's Spirit Rover, located at 15° south, recorded 35°C. https://mars.nasa.gov/mer/spotlight/20079612.html

Some facts about Elon Musk's project; key information is available on YouTube:

Starbase Tour with Elon Musk [PART 1] https://www.youtube.com/watch?v=t705r8ICkRw
Starbase Tour with Elon Musk [PART 2] updates https://www.youtube.com/watch?v=SA8ZBJWo73E

There have, over the years, been numerous presentations about Mars, how to get there, and what we could do when we arrive. Musk's discussion was different because it came from the head of a company that is presently constructing space vehicles with the intention of making this reality over coming years. Don't bother to reach for any space engineering glossary: BFR contains an expletive relating to the size of his big rocket.

Abridged transcript of Elon Musk's presentation at the 68th International Astronautical Congress on September 28th, 2017 in Adelaide, Australia. https://relayto.com/spacex/making-life-multiplanetary-ddvqil46/pdf

Elon Musk, CEO and Lead Designer of SpaceX, emphasised the excitement of this new space age. "You want to wake up in the morning and think the future is going to be great - and that's what being a spacefaring civilisation is all about. It's about believing in the future and thinking that the future will be better than the past. And I can't think of anything more exciting than going out there and being among the stars."

Musk has argued that by the 2060s, Mars could be supporting a population of a million. https://www.nationalgeographic.com/science/article/elon-musk-spacex-exploring-mars-planets-space-science

Governance of Mars – tough questions that will have to be addressed.

Who will run Mars? Ahead of us loom well-trodden paths of science fiction, but now they must be revisited with urgency and explored in more depth. Substantial societal problems remain unresolved in the real universe. In legal terms would a colonised Mars be an outpost from nations or from the United Nations, back on Earth? Who would govern these human colonies? Companies? Oligarchs? Plutocrats? Dictators? Religious leaders? Constitutional democracies? Would the immediate or eventual response of a colony be to declare itself as an independent government? Who would be able to travel to and live on Mars? The extremely rich? Lottery winners? Political party members? Would there be a representative selection of the Earth's ethnicities? Who would be making these decisions? For those who desire a free society, how could such a society be ensured when it can exist only within the confines of artificial bases, where the survival of all would require that the behaviour of colonists be controlled closely? How should we respond to the possibilty of colonies created by different nations involved in destructive competition or warfare here on Earth?

Today, down here on Earth, we have not, on a universal scale, resolved questions of governance. Instead, during the millennia that towns and cities have existed, there have been attempts to create new and perfected societies, sometimes at new locations. We must seek to learn from dystopias, derelict cities and lost peoples.

Beyond dystopias: We are already aware that human psychology and physiology pose major problems that would have to be resolved before we could live on Mars.

The psychological and physiological challenges of living on Mars would be substantial. The difficulties of extended lockdowns at home have been emphasised during the global COVID-19 pandemic. We must expect a wealth of psychological data to emerge. Being locked-in would become the norm for life on Mars. Outside, there would be unbreathable atmosphere and cold landscapes. Much that we take for granted on Earth would become impossible on Mars. In most societies on Earth, it is possible to step away for a while from social pressures. In the countryside, we can hike off alone through woods and beside fields. In the centre of New York or London, we can walk among the anonymity of thousands of passersby. They are a human presence, but they are not family, friends, supporters or rivals. One can escape for a while and think ideas through by oneself. The threat of introspection, with people questioning the purpose of their lives or the actions of the authorities, has always been a matter of suspicion by dictatorships, cults, and any kind of totalitarian rule, because they consider themselves as having already arrived at the perfect model for society.

The long-term physiological responses to Martian gravity (a mere 38% that on Earth) need to be addressed also. We can refer readers to insightful discussions by journalist Nadia Drake about the difficulties that must be overcome before humans can reach Mars and live there, which have been published by *National Geographic*.

In the article (December 10, 2018) “Can humans have babies on Mars? It may be harder than you think” she invited medical expertise and received the answer:

““All of our big tech gurus out there who want us to be a multiplanet civilization—this is a key question that no one has answered yet,” says Baylor College of Medicine physician Kris Lehnhardt who specializes in space medicine.”

https://www.nationalgeographic.com/science/article/can-humans-have-babies-on-mars-space-it-may-be-harder-than-you-think

Mars colonies will throw into sharp relief the problems that we see presently down here on Earth of how to run our societies, including the provision of physical and psychological health.

Human conflict in space.

At the time of writing, the Earth's two major nations in space, the USA and Russia (who are obliged to work together at the International Space Station) are challenging each other (as far as nuclear powers dare) in the Ukraine war.

There has been assertion and discussion about a Mars community being able to survive a catastrophe on far-distant Earth, but an escape to Mars would not necessarily mean escape from war. If people can travel to another planet and establish a colony, so also could weapon systems follow them from Earth. Attention should be given to how Earth's warring nations might understand Mars colonies as potential friendly or hostile outposts.

The idea of conflicts between the inhabitants of astronomical bodies appeared famously from the satirical pen of the second century Lucian of Samosata (lived about 125 to after 180), who opens by telling us "I am not telling a word of truth" in his *A True Story*. Otherwise, his story contains a significant truth, which is that physical conflict is a fundamental fact of human psychology, in whatever situation humans are thinking about.

It was from the darker imagination of H. G. Wells (1866-1946) that a worldwide public became acquainted with the threat of space warfare. It was during an era when large telescopes were being focussed on Mars as a potential home for life or civilisations, and, here on Earth, railroads and canals were crisscrossing the lands, armies and navies clashed and indigenous peoples could be exterminated by those with greater technology. These were the historical circumstances in which Wells wrote his classic invasion from Mars story "War of the Worlds" (1898). This idea of invasion from space has become a staple motif in books, film and TV, and it has engaged us for about one and a half human lifetimes. All of these stories have come from the human mind, as we play and explore with the idea of conflict.

Space vehicles have existed for a nominal human lifetime of 80 years. It began with the killing machines developed by the Nazi war effort, with hideous treatment of slave workers. In these circumstances, Walter Robert Dornberger (1895-1980) of the V2 programme, announced with triumph on October 3, 1942, that the first successful launch of a V2 (reaching 84.5 km) had seen "a new era in transportation, that of space travel." By June 20, 1944, a V2 reached an altitude of 174.6 kilometres. These were the harbingers of the intercontinental ballistic missiles with which nations continue to threaten each other today.

The threat of *Homo sapiens'* intraspecific conflict continues to expand into space. A manifestation was the creation in 2021 of a UK Space Command, in alliance with the USA, which sees the likelyhood of strategic issues coming from Russia and China.

One way or another, the greatest risk to the human race, continues to be posed by ourselves.

Martian life – an unknown threat. Could we harm it? Could it harm us?

Finding some kind of life on Mars, might resolve important scientific debates. Could Martian life be so different from ours that it raises questions about how we define life? Could it turn out to be so similar that we must ask if life has been exchanged naturally between the worlds? The low gravity of Mars would have made it easier for asteroid impacts to hurl meteorites containing life from the Mars' surface into space. Did Earth's life arrive from Mars? Are we going home? These are discussions for another occasion. We must, however, ask, on behalf of the environmentalism of the 21st Century, whether colonists, having damaged or destroyed so many species on the Earth, would turn over a new leaf or decide to sacrifice the old Mars for the new human Mars.

Another set of questions was raised in the challenging article in *National Geographic* (December 3, 2018) "Will Mars missions make humans sick? Here's what we know". If Martian microbes are alive today, could they, in principle, pose a threat to human explorers and colonists? If they exist, we will encounter them. Drake said "The problem is that people might also want to tap into the planet's subterranean resources, which could expose them to potential Martian germs" She quoted Cheryl Nickeron of Arizona State University "We better figure out what the microbes are doing in response to the spaceflight environment before you just send humans up there for long-term flight,"

https://www.nationalgeographic.com/science/article/will-mars-missions-make-humans-sick-bacteria-diseases-space

It should be noted that these potential problems are not unknown, and further information can be obtained from NASA's Office of Planetary Protection.

This department explains: "Planetary Protection is the practice of protecting solar system bodies from contamination by Earth life and protecting Earth from possible life forms that may be returned from other solar system bodies. NASA's Office of Planetary Protection promotes the responsible exploration of the solar system by implementing and developing efforts that protect the science, explored environments and Earth." https://sma.nasa.gov/sma-disciplines/planetary-protection

The Terraforming Paradox and Planet B.

Terraforming - converting another planet into a new Earth - has become a widespread concept. The conundrum is this, that while we are struggling to overturn the powerful political and economic forces that are undermining or actually destroying ecosystems on Earth, we must posit that some super-benevolent entity will provide the means to create another Earth-like planet for human habitation.

Moreover, in planetary engineering terms, any astronomical body available to us in the Solar System, would be orders of magnitude more difficult to terraform than us restoring the natural functions of the Earth. We dream of making beautiful new worlds, while we remain unable to prevent ourselves from undermining the habitability of the beautiful planet we already have.

One often sees protestors waving placards that warn us that we do not have a Planet B. The bad news is that if there were a Planet B, and were we to exploit it at the same rate as our Earth, it wouldn't last very long.

Let us suppose, for the purposes of argument, that there actually *were* a Planet B, a very close Earth analogue, but without any existing human-like populations. Ignoring the question of how we could get there, let us assume that we could move over half our population, together with cities, industry, mining, agriculture, fishing, transport systems etc.. Planet B would not double the lifespan of our civilisation. The reason is that we are producing exponential growths of population and use of resources. During the last nominal 80 year life time, human population has increased by roughly a factor of three and a quarter. However, half the global human population has appeared since 1974; approximately from 4 billion to 8 billion on a timescale of about half a century.

The former International Geosphere-Biosphere Programme argued for a Great Acceleration since the mid 20th Century: "The last 60 years have without doubt seen the most profound transformation of the human relationship with the natural world in the history of humankind."

http://www.igbp.net/globalchange/greatacceleration.4.1b8ae20512db692f2a680001630.html

A human future on Earth or Mars would require us to look beyond the fantasies, and tackle hard realities.

The Moon is the first step towards Mars.

NASA's Artemis missions should have returned humans to the Moon by 2024, but has slid back. The plan includes a space station orbiting the Moon (the Gateway).

https://www.nasa.gov/specials/artemis/

The old debates of the Apollo Program, as to whether our priorities should be here on Earth or out in space, will re-surface.

Half a century ago, there was intense argument about whether funding should be be better spent here on Earth, where there were major societal issues in the USA and elsewhere. This was an age in which environmental conciousmess was growing. 1962 saw the appearance of the classic *Silent Spring* from USA marine biologist Rachel Louise Carsom (1907-1964).

According to the *Planetary Society*, Project Apollo cost $25.8 billion ($257 by 2020 standards). Add the cost of the precursor Project Gemini and robot missions, and the total was $49.4 billion, the equivalent of $482 billion by 2020 values. In contrast, the cost of the 1955 to 1975 Vietnam War, with fuel thrown on the fire by the 1964 Gulf of Tonkin episode, cost $843.63 (2019 values).

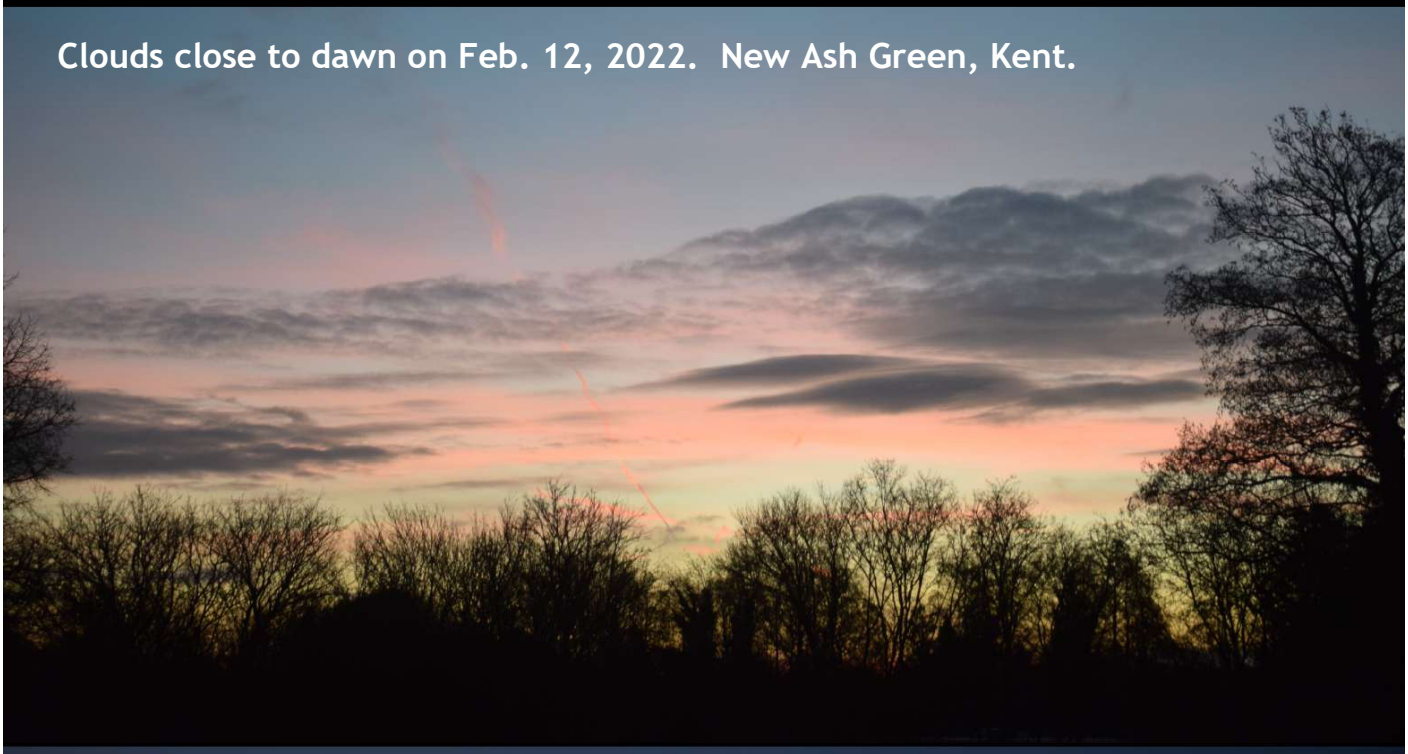
For many of us the Moon landings and the robotic explorations of the planets ignited an astonishing adventure in which *Homo sapiens* developed a much deeper understanding of itself and the history of the Earth. We continue to explore how life may fit into the Solar System and how complex life might exist on worlds around other suns. Some of us spoke out for Earth's environment too. Reality versus fantasy? Humanity might have gone into space as well as tackling the problems here on Earth, committing substantial resources to preventing our technological civilisation undermining natural life support systems, rather than warfare. Ultimately, that might be the only realistic way for us to survive.

Cost of the Apollo missions: https://www.planetary.org/space-policy/cost-of-apollo#:~:text

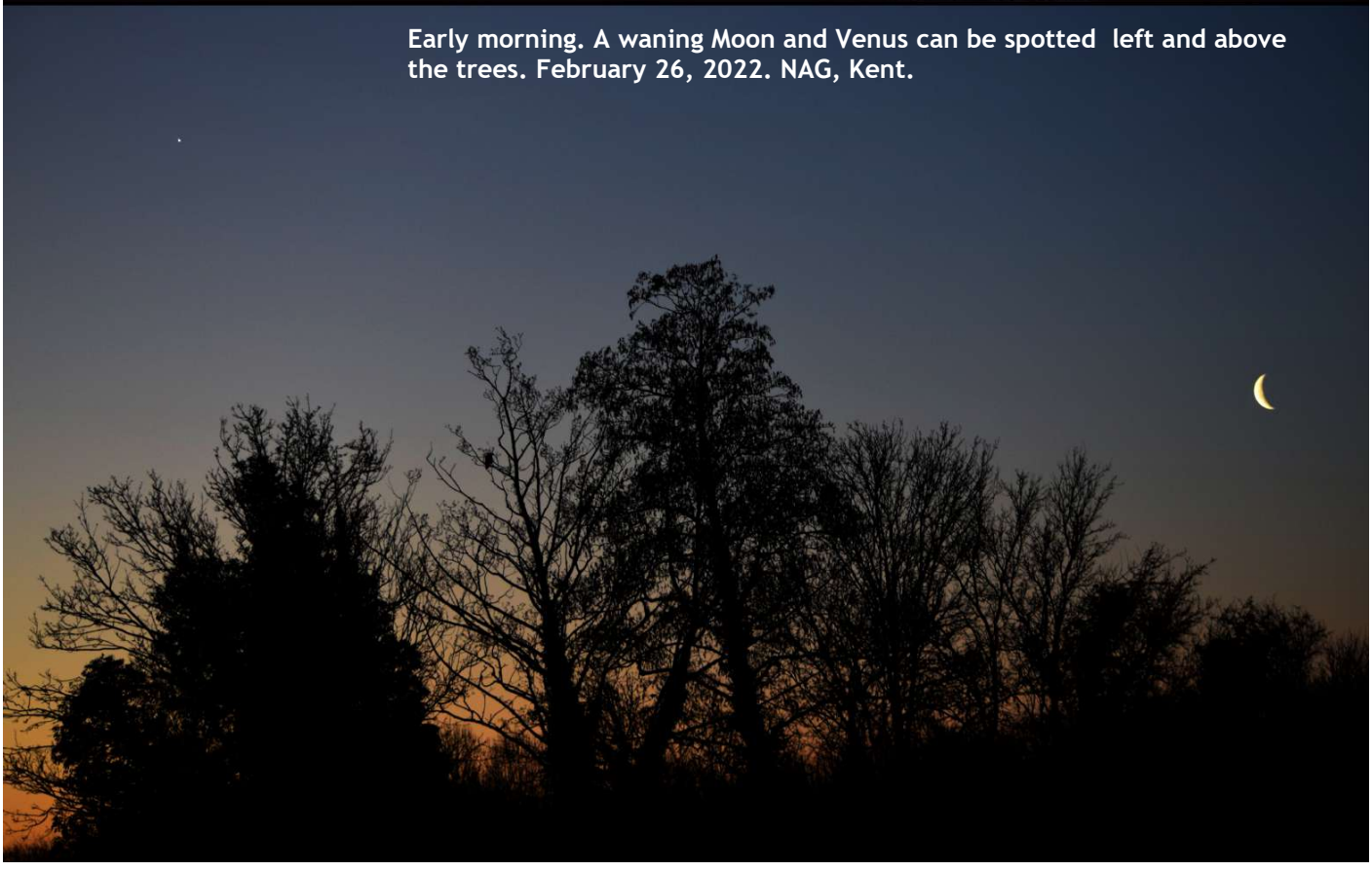
Cost of Vietnam War (and other conflicts): https://eu.usatoday.com/story/money/2019/06/13/cost-of-war-13-most-expensive-wars-

Above: Our Moon from Hartley, Kent on July 6, 2022,

A few views of the Moon in our sky. Full Moon took place on Feb. 16, 2022,



Clouds close to dawn on Feb. 12, 2022. New Ash Green, Kent.

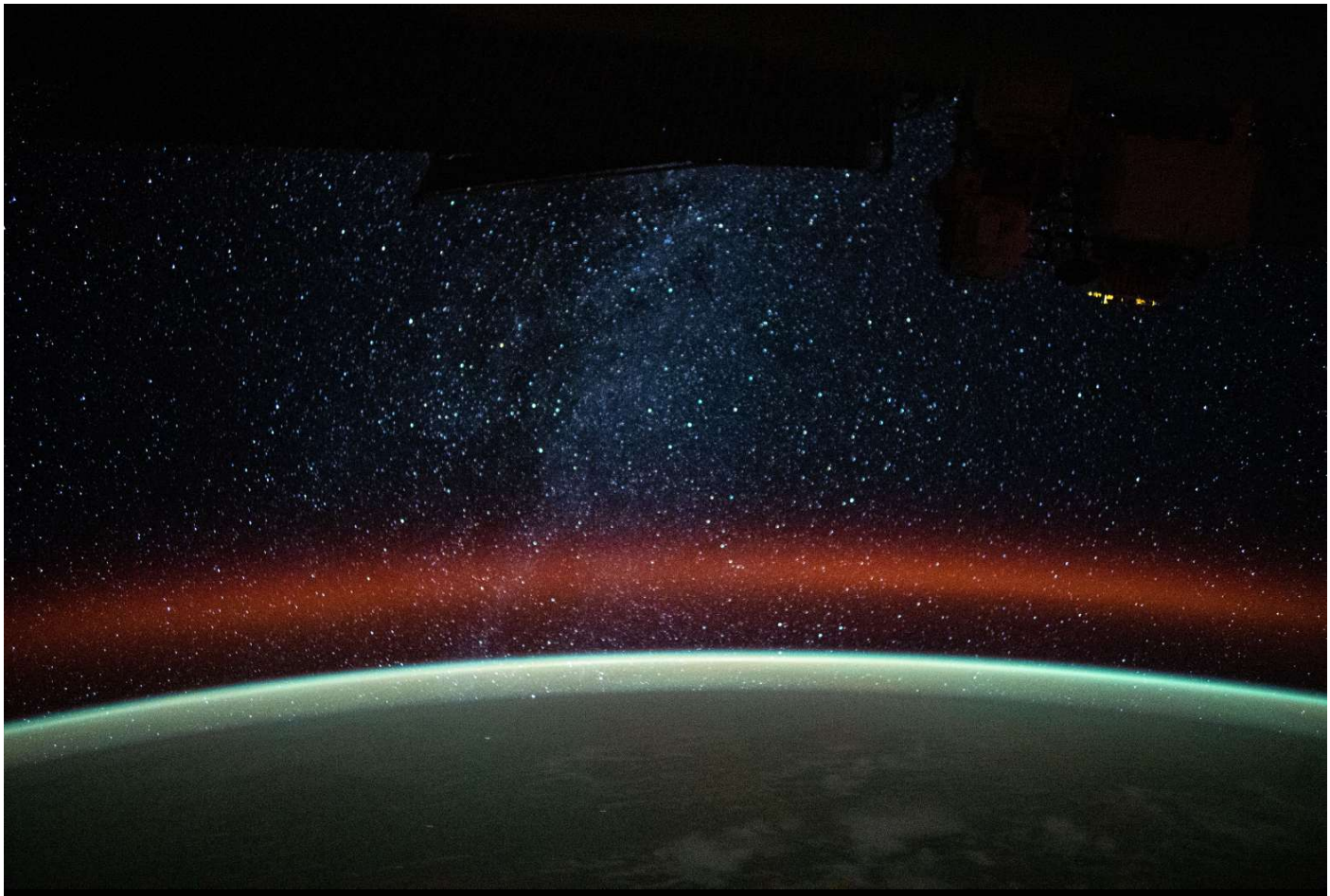


Early morning. A waning Moon and Venus can be spotted left and above the trees. February 26, 2022. NAG, Kent.

Full Moons took place on March 18 (above) and April 16, 2022 (centre). The Full Moon appeared reddish low in the sky. From a hill at Hartley, Kent.

Below: A Full Moon took place on May 16, 2022. The Moon could be seen in eclipse, but this took place as the sky was growing brighter towards dawn.

The Full Moon on the morning of May 16, 2022. Looking across a field at Ash, Kent, we could see the Moon being caught as the Earth's shadow was crossing it. The Moon does not completely disappear at such times, but even at totality (not photographed here), light from the Sun gets through the Earth's atmosphere.



Above: A picture from the International Space Station some 416 km above the island of Vanuatu (NE of Australia) on May 30, 2022. This view, published by NASA and using a long-duration photograph, looks beyond the Earth's air glow and out into the stars of the Milky Way. Is that where our future is beckoning?

Prime Meridian.

Prime Meridian is published by the Ecospheres Project, a research and media collaboration. It looks at the cycle of the seasons in South East England and looks out from the Prime Meridian into the global environment. It steps back to look at the Earth in its astronomical context. The threat caused by human activity to the ecosphere of Planet Earth goes beyond climate alone. The Earth Crisis, as we have called it, involves numerous factors, which interact with each other in a complex way. The authors pursue also the search for other habitable worlds. This is an area of research in which the editors have been active. We assert the moral duty of space exploration to inflict no harm on life elsewhere from human impact.

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