SPACE

The alien hunter of Harvard

Did Avi Loeb spot an extraterrestrial spaceship in the night sky – or was it merely the reflection of his own obsessions?

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BY OSCAR SCHWARTZ

There are almost two dozen observatories dotted across Hawaii. The dry, thin air atop the volcanoes of the archipelago makes this an ideal place to gaze into the night sky. Over the past decade, the telescopes here have probed deep into neighbouring solar systems, transforming our understanding of the galaxy. Many used to think that Earth was an anomaly within a cosmic void. Now astronomers have identified thousands of planets and reckon that the Milky Way is filled with billions more, many of them similar to ours.

On a clear summer's night in 2017, a crowd gathered at an observatory near the treeless summit of Mauna Kea, Hawaii's highest volcano, to listen to one of the world's foremost astronomers deliver a lecture about these far-away planets: are they all barren or might some be hospitable to life?

Dressed in a dark suit and orange *lei*, Abraham (Avi) Loeb, a professor of astrophysics at Harvard University, stated his belief that there are a number of planets teeming with life, perhaps even intelligent life. Scientists should devote more resources to searching for it, he said: "We might find advanced civilisations out there."

Almost exactly three months later, an unusual object was spotted through the Panoramic Survey Telescope and Rapid Response System, a network of telescopes 130km north-west of the observatory where Loeb had made his speech. The object was moving along a strange trajectory through the solar system. The U-shaped flight path that it took around the sun made it clear that it had, in fact, arrived from beyond the edge of our solar system. It was dubbed ‘Oumuamua, which in Hawaiian means “a messenger from afar, arriving first” (the term usually refers to a military scout).

Scientists have long predicted the existence of interstellar objects, but this was the first one that had ever been spotted. Most presumed that these objects would be chunks of ice or rock ejected from other star systems. ‘Oumuamua did not look like any regular meteoroid or comet. It was weirdly shaped, much longer than it was thick – like a cigar, perhaps, or a pancake. It was unusually bright. Strangest of all, its trajectory could not be accounted for by the sun’s gravitational force alone.

In astronomy an unknown phenomenon is a theorist’s playground. After ‘Oumuamua was observed, a number of people put forward unconventional hypotheses to explain its strange features: it could be an iceberg made of pure hydrogen or a giant dust ball. The exotic shape and movement of ‘Oumuamua suggested to Loeb something even odder: a paper-thin metallic disc pushed, like a sail in the wind, by radiation pressure from sunlight. An object like this could not have been formed naturally. So Loeb pondered whether ‘Oumuamua might have been artificially constructed. Was it an advanced piece of technological equipment?

There have been many moments in modern astronomy when scientists have seen something unusual in the heavens and screamed "Aliens!", only to find a natural explanation for the imagined sign of life. In the 1960s, what were thought to be radio signals from advanced civilisations turned out to be pulses of radiation from distant stars. Some scientists argued that the strange dimming of one star, spotted in 2015, might have been caused by an alien megastructure. In fact, giant clouds of dust were obscuring the telescope's view. The media inevitably seizes on cases such as these, sometimes vaulting astronomers who cry alien to sudden prominence. In reaction, an adage has taken root among astrophysicists: "It's never aliens."

First contact would be a moment of revelatory, even redemptive significance for a divided world

Undaunted by this taboo, Loeb pursued his theory that 'Oumuamua might have been made by a species from elsewhere. Many of his colleagues were less enthusiastic. Some felt that his chain of inferences was too long and speculative. Others caught a whiff of self-promotion. As one of Loeb's colleagues put it, "He was interested in the limelight and the main stage."

Several years on, Loeb remains steadfast in his hypothesis. He feels that most modern astronomers are unwilling to countenance the possibility of extraterrestrial intelligent life and compares them to the 16th- and 17th-century clergymen who refused to believe Copernicus and Galileo that Earth rotated around the sun.

When the astronomers spotted 'Oumuamua it had already passed by the sun and was heading out of the solar system. Now that 'Oumuamua is billions of miles away it is hard to resolve the crucial question it raised: has modern astronomy wilfully blinded itself to the possibility of intelligence beyond our planet? Or did this great astronomer look into the stars and see his peculiar obsessions reflected back?

Two days before the American presidential election of 2020, I drove from New York to Massachusetts to visit Loeb. A convoy of cars and trucks commandeered the middle lane of the motorway, beeping and waving flags adorned with "Make America Great Again". The pandemic was roaring back to life across the country, yet one of the pick-ups was flying a large banner that read

Lexington, a town north-west of Boston where Loeb lives with his wife and two teenage daughters, seemed calm by comparison. Loeb was waiting for me outside his grand New England house wearing a suit and tie, his hair neatly parted. On his front porch two white rocking chairs faced each other, three metres apart. Two portable heaters had already been turned on to keep us warm during our socially distanced interview.

The pandemic suits Loeb's lifestyle. He appreciated social distancing "long before it became trendy", he said. "To maintain creativity, you have to distance yourself from the crashing waves of mediocrity and criticism because otherwise it will crush you." Though he spoke gently, he clearly relishes scientific combat.

Growing up on a pecan farm in Israel, Loeb had plenty of time for introspection and dreamed of becoming a philosopher. In the evening, after collecting eggs from the chicken coop, he would drive a tractor into the fields to read Jean-Paul Sartre and Albert Camus, and scrawl existential screeds in his diary: "Here I am again – a block of cells filled like an eclair with sadness."

During his stint doing national service he had to put his philosophical ambitions on hold. He was recruited into a programme for gifted students: he did a PhD in physics and contributed to research on launching projectiles with electrical discharges. "I thought it was better to do intellectual work than running through the fields with a machinegun," he said.

After his military service, Loeb was offered a post-doctoral position at Princeton's Institute for Advanced Study. He found the austere academic environment disorientating. In the army he'd been part of a collaborative enterprise. Here he was on his own, competing with colleagues for intellectual prestige.

The institute had made him switch to astrophysics, which he hadn't studied before. "I didn't know the vocabulary, I was always having to ask my colleagues some very basic things," he said. "It was embarrassing." It felt like being thrust into an "arranged marriage". He had no opportunity to tackle the fundamental questions that drove him as a boy. "I was being taught to only look at the universe as this physical thing, quantitatively assessing what it's made of, how it evolved, and so forth," Loeb said. "It was an exile from the pleasure and curiosity of my youth."

Driven in part by these insecurities, Loeb pushed himself to become an exacting and productive scientist, frequently publishing in high-profile journals. In 1993 he was offered an associate professorship at Harvard. Three years later a tenured position in the astronomy department came up, the first for many years, and Loeb was appointed.

A star is born The "Pillars of Creation" in the Eagle Nebula, where infant stars are created within clouds of dust and hydrogen (top); Though the central star of the Helix Nebula glows red, it is in fact a white dwarf, one of the last stages of star's evolution (middle); The North America Nebula resembles the continent in visible light but this infrared image pierces the dust cloud to show the glowing cocoons of newborn stars (bottom)

Suddenly freed from the need to impress his superiors, Loeb began to consider more creative research questions. At the time little was known about how stars – the most common celestial objects – came into existence. Study of the early universe was hampered by a lack of observational data. Along with others, Loeb developed a picture of it as a hot soup of radiation and matter – mainly helium and hydrogen – spread more or less evenly across the expanding cosmos. In this cosmological dark age, matter began to clump together. These lumps in the cosmic

The odd thing about astrophysics as a discipline is that the world beyond our own is so little understood and difficult to explore that sometimes it requires a flight of imagination – almost a fantasy – to push the boundaries of possible research. Then scientists have to find a way to test these notions with observational data.

Loeb theorised that the early star systems emitted hydrogen at a unique 21cm wavelength. By the mid-2000s, instigated by Loeb's hypothesis, purpose-built long-wavelength radio telescopes were under construction, designed to probe the universe for traces of this ancient atomic charge. As Robert Kirschner, a former chair of the astronomy department at Harvard, said, that's about "as big a deal as you can get for a theorist".

One challenge researchers encountered when trying to detect these radio emissions was background noise from Earth-bound radio and TV stations. This gave Loeb an idea: if our civilisation emitted radio detritus, other civilisations might too. In 2007 he co-wrote a paper explaining how astronomers could listen out for alien radio leakage as they searched for hydrogen from the dawn of time.

Scanning the skies for radio signals from extraterrestrials was not a new idea. Two physicists from Cornell University proposed doing so in a paper in Nature in 1959, which gave rise to a new field of astronomy known as the search for extraterrestrial intelligence (SETI). Scientific interest in SETI was significant in the 1960s and 1970s. In America and the Soviet Union the hunt for alien life-forms formed part of the broader cold-war space race. Each power wanted the glory of being the first to make contact with another civilisation. From rural Ohio to the Caucasus, telescopes sought messages from other worlds.

It requires a cosmic humility to recognise a signal from another intelligence

The prospect of first contact caught the public imagination. Scientist-philosophers such as Carl Sagan used SETI as a way to educate TV viewers in America about the wonders and mysteries of the cosmos. Communicating with aliens became a preoccupation for some New Age communities, too. UFO religions such as the Seekers claimed that they were already interacting with non-human intelligences. Groups were motivated by differing impulses, but the hope that we would detect intelligent neighbours was widespread. First contact would be a moment of revelatory, even redemptive significance for a divided world.

But no aliens showed up. Those supporting the search for extraterrestrial life began to grow weary. Congress withdrew funding from the official SETI programme in 1993. Richard Bryan, a senator for Nevada, said he hoped this would mark "the end of Martian-hunting season at the taxpayer's expense". Lack of funding did little to quell the public's fascination with alien narratives – "The X-Files" ran through much of the 1990s. Yet many mainstream scientists scorned the search for extraterrestrials as a speculative field of interest only to eccentrics.

Loeb, a staunch rationalist and no fan of science fiction, initially shared this prejudice. He started to change his mind part way through his career. Until the mid-2000s no one knew whether a planet with conditions that facilitated life on Earth – rocky, medium-sized, orbiting the sun at a distance that allows liquid water on the surface – was exceptionally rare or occurred with regularity across the universe. Many assumed that life on Earth was a fluke.

Starting in around 2007, high-powered telescopes revealed that there were thousands of exoplanets rotating around sun-like stars in small sections of our galaxy alone, some of which looked similar to our own. The idea that we were all alone struck Loeb as myopic. "For me, the equation became simple," he said. "If we have life on Earth, and now have data from telescopes showing that conditions similar to the Earth exist on millions of planets in the Milky Way, what is speculative about saying that the same outcome that we have here might have happened elsewhere?"

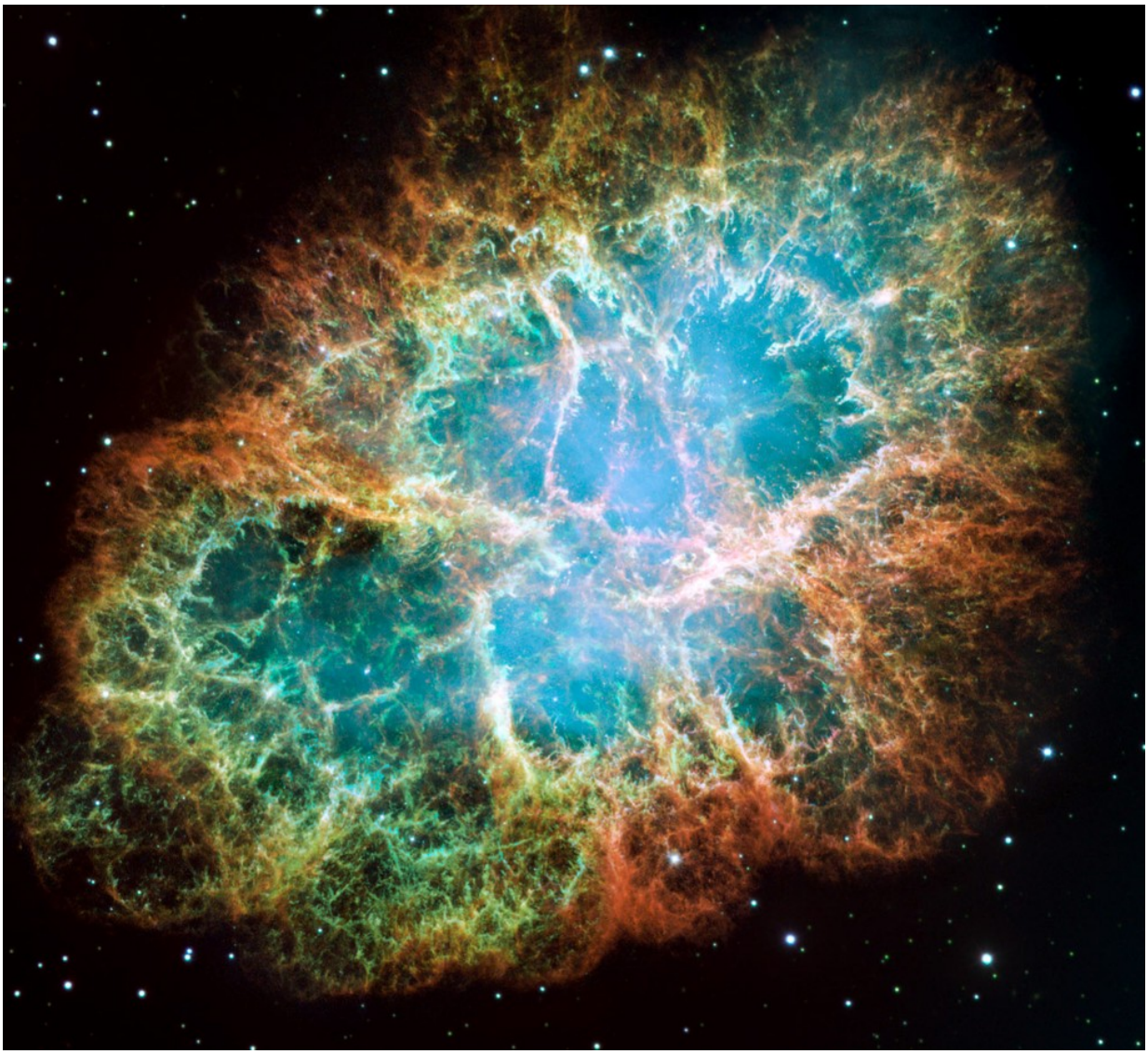
Loeb published papers outlining new approaches for the search for extraterrestrial life. Much effort had been put into scanning the cosmos for radio signals, but what if alien civilisations left behind other types of technological signature? Could we detect the artificial lights of distant cities or industrial pollution in the atmosphere of another planet? If a civilisation died out long ago, might we invent tools to excavate evidence of its existence from the depths of space?

Those who had tended the flame through SETI's dark age in the 1990s and 2000s were often stigmatised or belittled for their work. Funding and institutional support were hard to come by, a reality dramatised in "Contact", a film released in 1997 based on the beleaguered career of Jill Tarter, a pioneering SETI researcher who spent her career pursuing – and failing to find – life in space.

Loeb entered the field just as the chances of detecting life elsewhere seemed promising once more. In 2015 he was approached by Yuri Milner, a billionaire technology investor, to oversee a speculative project to send a probe four light-years away to Alpha Centauri, the closest star system to Earth. Milner was driven by a personal ambition to make contact with extraterrestrials in his own lifetime: he stipulated that the mission had to be completed within 25 years.

For a theorist like Loeb the engineering challenges involved were hard to comprehend. A probe would need to travel at a fifth of the speed of light – or faster – and survive a journey of up to 20 years through interstellar space, while facing the constant threat of freezing temperatures, collisions with dust and gas clouds, and degradation from cosmic rays.

Loeb brainstormed possible strategies with a group of post-docs and students and eventually settled on an idea. If they could aim an extremely powerful laser onto a razor-thin piece of metal and launch it into space, it could reach one-fifth of the speed of light within ten minutes of launch. They could send thousands of these probes in one go to increase the chance that one would survive the journey.



The idea of a sail travelling on radiant energy had been around for hundreds of years, but no attempt has yet been made to realise it. To translate this concept into a viable machine required technology that doesn't exist at the moment: a laser with the power of a large nuclear reactor and micro-thin, lightweight materials that can endure extreme acceleration. Nevertheless, with a $100m budget, Loeb believed that such a device was the best bet.

In April 2016 Breakthrough Starshot was officially launched at the observatory deck of One World Trade Centre in New York. Loeb was thrust into the public eye. "I used to be just in that mode of academia – doing detailed calculations, trying to impress colleagues, trying to convince people that you're smart," he said. "And then suddenly I came into this different world."

The morning after our interview on the front porch, Loeb and I went for a walk near his house, along a lightly wooded trail where he jogs each morning before dawn. By the time I arrived at 9am, he had been up for five hours, sending emails and finishing one of his regular essays for the *Scientific American*. Loeb's productivity is extraordinary. He has written around 800 papers and eight books. He was the longest-serving chairman of Harvard's astronomy department and is a dedicated mentor to his many PhD students and post-docs. Somehow, he also had time to answer all my emails seeking minor points of clarification within a few hours.

He has made sacrifices along the way. Loeb looks back on his early years in America as a lonely slog. Sometimes he dreamed of returning to the family farm to help his father harvest pecans. Loeb's first marriage disintegrated shortly after he got tenure at Harvard, as both he and his wife concentrated on their respective careers. He met his current wife, Ofrit, soon after.

There have been many moments in modern astronomy when scientists have seen something unusual in the heavens and screamed "Aliens!"

Loeb showed me around the property in Lexington where he raised his two daughters. He does his best thinking in a small ravine filled with yellowing trees at the back of the house, far from what he considers to be the stultifying atmosphere of campus. "I also do some of my most important theorising in the shower," he said. He keeps a waterproof whiteboard in the bathroom to make sure he doesn't forget any insights that come to him there. A film crew once came to interview him at the house and he told them about this set-up. "They asked to film the shower," Loeb said, smirking. "But I told them, 'it's not the shower that's special, it's my brain.'"

Loeb comes across as supremely self-assured about his own genius. Yet somehow he manages to denounce what he sees as the narrow-mindedness of the academy, while navigating its treacherous waters with diplomatic skill. The colleagues and students I spoke to all noted that he has a rare combination of extreme efficiency and almost childlike open-mindedness to ideas, no matter how far-fetched.

His reputation has given him the confidence to take risks. He now regularly publishes surprising ideas across a broad domain. He has proposed, for instance, that our universe might have begun when a previous one shrunk and then rebounded back again – a Big Bounce rather than a Big Bang. As Edwin Turner, a professor of astronomy at Princeton University, put it: "He is a batter who swings for the fences, which means he either hits home runs or strikes out."

Loeb knows that some colleagues consider him prone to tendentious speculation. "As a young scientist I was terrified of what people might think about me because I had to maintain my job," he said. "Now I don't give a damn. I just want to find the truth with whatever I look at."

If something strikes him as interesting, he pursues it. When the Panoramic Survey Telescope observatory in Hawaii announced that it had observed a mysterious interstellar object in October 2017, Loeb's curiosity was sparked. He immersed himself in the data, eager to unlock 'Oumuamua's secrets. By the time 'Oumuamua was spotted, however, it was already 20m miles from Earth and heading farther into the distance. Since it was beyond the limits of direct photographic observation, astronomers had to infer information about the object from the way that sunlight reflected off it.

As 'Oumuamua rotated in space, its brightness varied ten-fold every eight hours. This suggested that it was thin and long. To understand why, imagine the difference between the way a tennis ball catches the light compared with a piece of paper. Whereas the ball reflects light evenly as it rotates, the amount of light a piece of paper reflects depends on its orientation to the light source – the flat side reflects a lot of light, the thin edge close to nothing.

Infrared cameras trained on 'Oumuamua could not detect any heat on the surface. If it were large, then radiation from the sun would have warmed its surface. The lack of heat meant that 'Oumuamua was estimated to be only around one hundred yards long and ten yards wide. It was also highly reflective, which indicated it may have a shiny surface. These anomalous features painted a picture of a little, luminous object that could either, according to the data, be elongated like a cigar or flat like a pancake. Nothing like this had ever been spotted in our solar system.

Intrigued by these anomalies, Loeb wondered if ‘Oumuamua might be an alien artifact. A high-powered telescope trained on the object failed to pick up any radio signals. Loeb let the idea drop until June 2018, when a team of scientists published a paper that analysed ‘Oumuamua’s flight path. They found that after ‘Oumuamua was propelled around the sun, it shifted from the path it ought to have travelled along if gravity alone were propelling it. The deviation was small but statistically significant, suggesting that the interstellar visitor was being pushed by an additional force which lessened in intensity over time.

Such non-gravitational acceleration is typical of comets: as they pass close to the sun and heat up, some of their frozen gases evaporate and these streams exert a force on the comet as they are emitted (much like the exhaust gases from a rocket exert a force on a spacecraft). This process is known as outgassing. For ‘Oumuamua to deviate as much as it did, it would have had to burn up a tenth of its total mass. Yet observations picked up no water, gas or dust emissions. Loeb also noted that outgassing comets generally accelerate in a jerky fashion, whereas ‘Oumuamua sped up and slowed down steadily, its velocity declining in inverse proportion to the square of its distance from the sun.

Boom and bust Clouds of hydrogen and sulphur swirl around infant stars in the Orion Nebula (top); A cosmic bubble blown by the bright star in the centre, which is building towards a supernova (middle); The luminous smudges in the Rosette Nebula are embryonic stars that will grow to ten times the mass of the sun (bottom)

Throughout the summer, Loeb puzzled over one question: how might a small, thin, luminous object accelerate without outgassing? One option he came up with was that it was propelled by radiation emitted from the sun. Shmuel Bialy, a post-doc at Harvard, crunched the numbers to see if this idea was feasible. The results were surprising. If 'Oumuamua was pushed by solar radiation, it would have to be extremely flat – less than a millimetre thick and at least 20 metres in diameter – and be made out of highly reflective material. In other words, it would look very much like one of the lightsails that Loeb was working to develop with the Breakthrough

Loeb and Bialy wrote a paper based on their calculations, submitted it to a journal and posted a manuscript to an open-source archive for pre-peer-reviewed research. The paper caught the eye of a few journalists whose reports focused on one particularly speculative line: "One possibility is that 'Oumuamua is a lightsail, floating in interstellar space as debris from advanced technological equipment." In other words, 'Oumuamua could be the product of extraterrestrial intelligent life.

The provocativeness of the lightsail hypothesis, combined with the institutional clout of a Harvard professor, meant the story quickly went viral. Subsequent news rewrites got further away from the original paper. Loeb and Bialy proposed not that 'Oumuamua was a lightsail, but that if its acceleration were due to solar radiation, 'Oumuamua would have to be made out of some thin, reflective material that was either natural or artificial.

Some of Loeb's colleagues sought to temper the hype. "Like most scientists, I would love there to be convincing evidence of alien life, but this isn't it," Alan Fitzsimmons, an astrophysicist at Queen's University, Belfast, told Agence France-Presse, a newswire. "The thing you have to understand is: scientists are perfectly happy to publish an outlandish idea if it has even the tiniest sliver of a chance of not being wrong," Katie Mack, an astrophysicist at North Carolina State University, tweeted. "But until every other possibility has been exhausted a dozen times over, even the authors probably don't believe it."

Loeb was deluged with phone calls and emails; television crews arrived uninvited to his office and home. Most coverage was curious and light-hearted, but not all of it. Loeb was described as "Harvard astrophysics's *enfant terrible*". Some insinuated that his involvement with Breakthrough Starshot lay behind his hypothesis, or at least skewed his scientific neutrality.

Without a publicist, Loeb embarked on his own communications campaign, developing a list of the key messages he wanted to broadcast. First, the scientific community was predisposed to disagree with his hypothesis. Second, science must be done according to evidence, not prejudice. Third, scientific debates should not only take place within the walls of the academy. As he said: "I basically saw it as an opportunity to let the public into the scientific process, with all of its uncertainties."

The lightsail hypothesis was just one among many. A scientist at NASA proposed that 'Oumuamua was a "monstrous fluffy dust aggregate", tumbling away from the sun. Another theorised that 'Oumuamua was a porous, fractal structure made out of ice. These theories offered natural explanations for 'Oumuamua's exotic features. Like the lightsail, these phenomena had never been observed before.

In July 2019 a team of scientists at the International Space Science Institute published a review of the existing 'Oumuamua hypotheses. They dismissed Loeb's lightsail hypothesis as "baseless". For the lightsail to achieve the propulsion required to account for the observed acceleration, they argued, its flat side would need to have faced the sun constantly, when in fact it rotated every eight hours. Moreover, the way 'Oumuamua reflected light was more consistent with a cigar shape than a hairline disc.

Loeb welcomed different theories but thought the review unfairly dismissive. According to his calculations, the lightsail didn't need to maintain a consistent orientation towards the sun to get the required momentum. Another scientist, working independently, had shown that a disc shape was far more likely to produce the recorded light-curve data than the cigar shape.

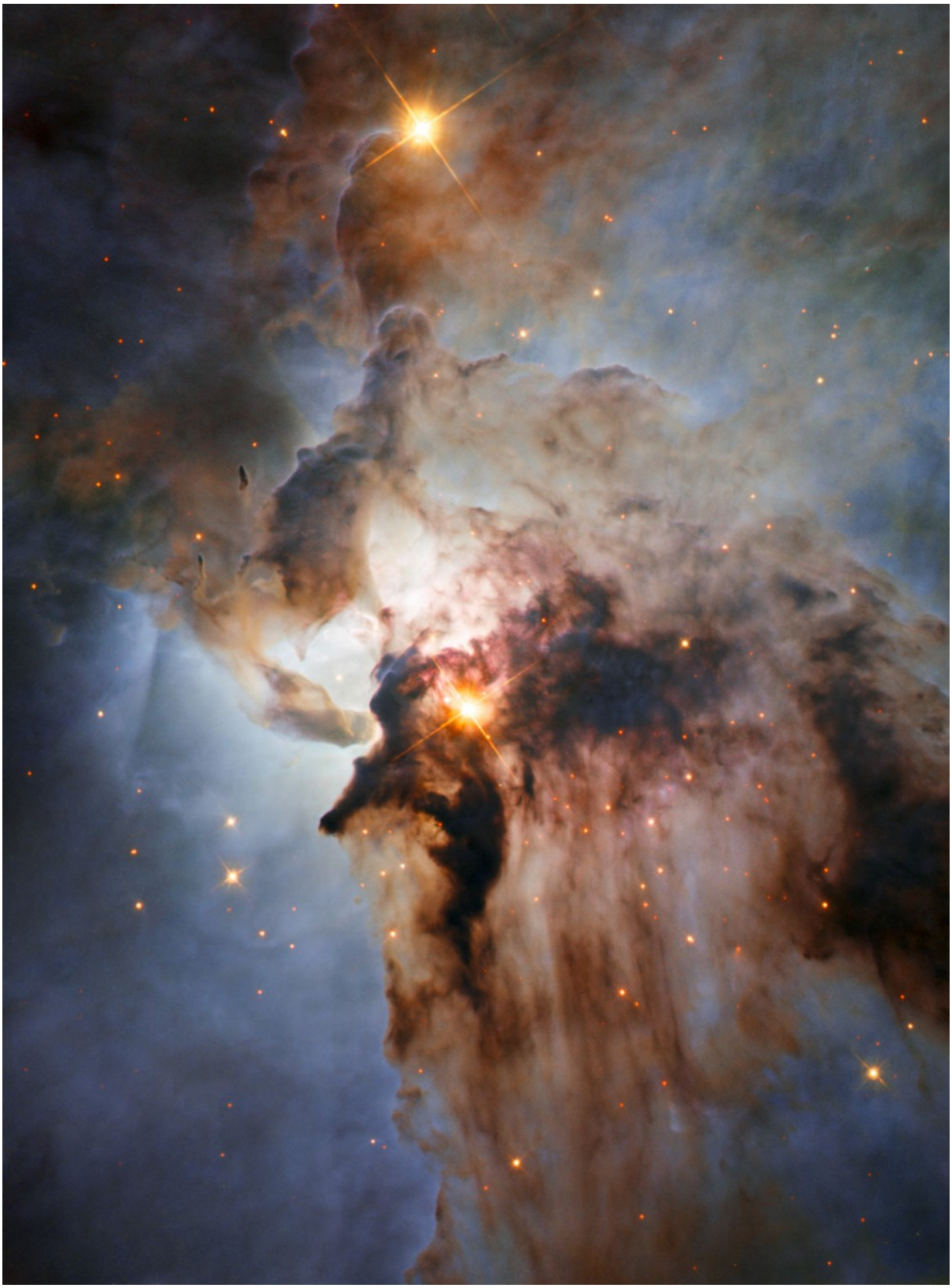
Loeb believes that the prejudice against extraterrestrials runs deep. Since he began publishing about SETI in 2007, "I was struck by how unwilling many esteemed astronomers were to talk about this topic with me," he said. Many of these scientists had spent their careers searching for phenomena whose existence is almost unimaginable – supersymmetry, extra-spatial dimensions, Hawking radiation spewing from black holes. Loeb was perplexed as to why academics were so reluctant to imagine the possibility of extraterrestrial life and engage with bold questions such as "are we alone?"

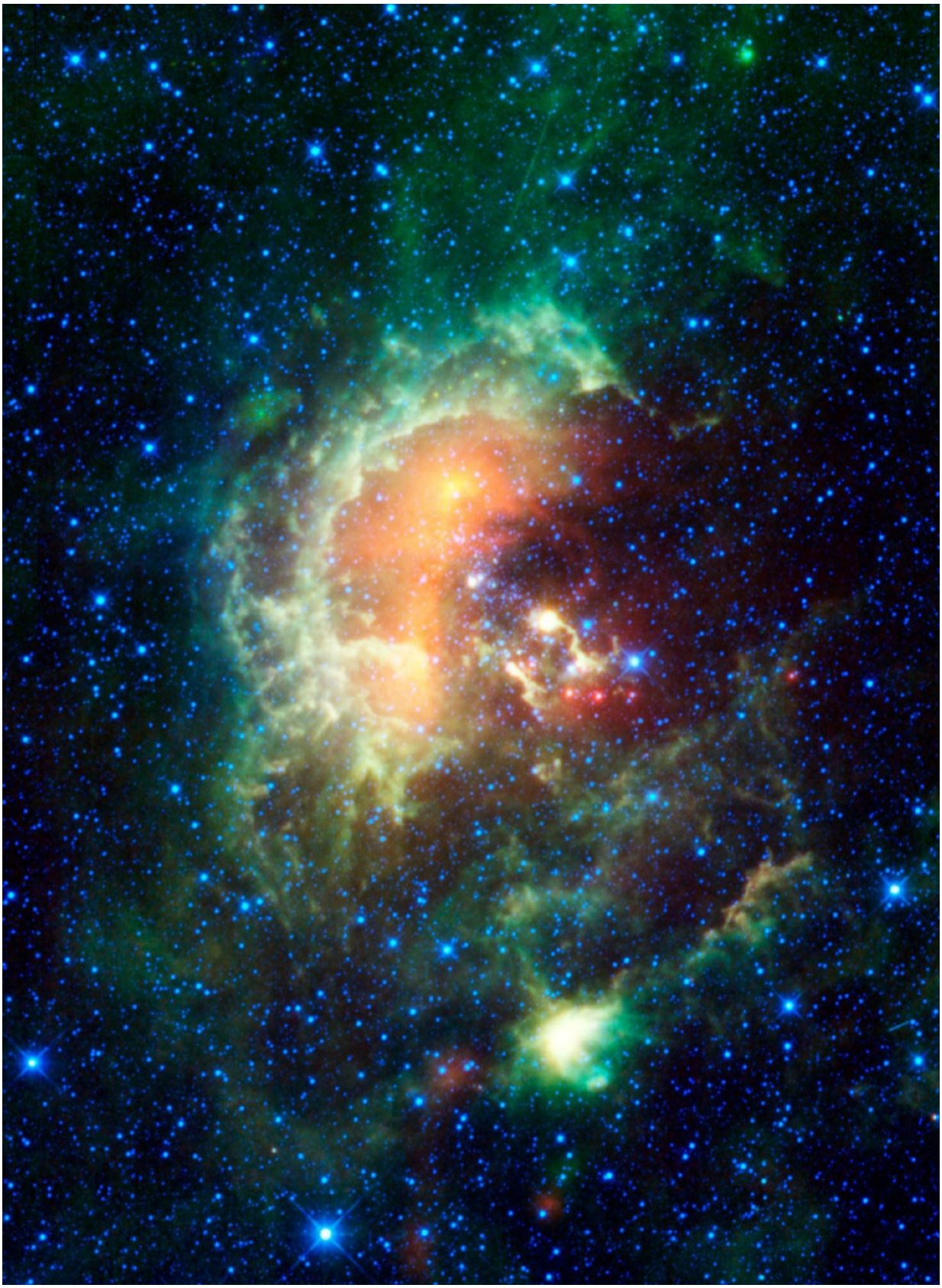
The hunt for alien life is nonetheless undergoing a renaissance. Astrobiology, a field that engages in the search for signs of habitability and biological life on near and distant planets, is booming. China, an emerging scientific superpower, recently finished constructing the largest radio telescope in the world, which will be used to look for other technological civilisations in our galaxy, among other things. Private capital continues to fund initiatives, such as Milner's Breakthrough Listen, a sister programme of Breakthrough Starshot, that has taken up the baton of scanning the skies for radio signals from afar. According to Jill Tarter, who worked in obscurity throughout SETI's leanest times, over the past decade the question of extraterrestrial life has "gone from the fringe of astronomy to the most obvious one to ask".

Michele Bannister, a planetary astronomer at the University of Canterbury in New Zealand, argues Loeb encountered resistance not to the idea of "aliens in general", but to his lightsail hypothesis in particular. Because 'Oumuamua passed our

In this kind of scientific free-for-all, alien hypotheses inevitably arise – they can explain just about any inexplicable phenomenon. We need "a hell of a lot of good proof" for aliens, she argues, and with 'Oumuamua "there simply wasn't enough". Bannister thinks the object is most likely to be a strangely shaped rock ejected from a distant planetary system.

Loeb has continued to marshal evidence in support of his hypothesis. A second interstellar object was spotted in the skies above Crimea in August 2019. It was clearly a comet outgassing as it made its journey around the sun. For Loeb, its regularity underscored just how unique 'Oumuamua was.





In September 2020 another object was detected by the Panoramic Survey telescopes. Like ‘Oumuamua, it seemed to be propelled by sunlight and had no obvious comet-like tail. After analysis, NASA scientists concluded that it was probably a stray rocket booster from NASA’s 1966 Surveyor 2 spacecraft. For Loeb, the fact that this shiny metal object moved much like ‘Oumuamua lent further credibility to the idea that the latter could have been a piece of space junk from a bygone civilisation.

‘Oumuamua is now hurtling through the Kuiper Belt, a region in the outer solar system beyond Neptune and no further direct data can be gathered. Astronomers hope that in the coming years the mystery of ‘Oumuamua will be solved indirectly as they learn more about other interstellar objects. A new telescope currently under construction in the remote desert of Chile will be able to pick up more light from distant astronomical objects than any previous optical telescope. Scientists predict it will discover one new interstellar object a year from 2022.

An adage has taken root among astrophysicists: “It’s never aliens”

If astronomers find other small, flat, shiny objects hurtling away from the sun with non-gravitational acceleration that turn out to be comets, ‘Oumuamua will become part of our ever-evolving taxonomy of natural objects in space. Loeb’s hypothesis will, in turn, be enfolded into a long history of people looking towards the night sky

After our walk, Loeb and I spoke about the future of alien research. He wants the search for extraterrestrial intelligence to become central to astronomy. In January he published "Extraterrestrial", a book that recounted his personal story of the 'Oumuamua saga. Later this year he and a colleague will publish an academic overview of the current state of the search for life, which Loeb hopes will become the defining textbook. He continues to give interviews and talks, and write essays for a popular audience.

Though his mission reflects his commitment to science, Loeb acknowledges that his youthful philosophical curiosity has been rekindled, too. An encounter with another intelligence, even an extinct one, would, he believes, invite an existential re-examination more profound than the Copernican revolution, when the case was convincingly made that Earth revolved around the sun, not vice versa.

In Loeb's most fanciful daydreams, he imagines an alien civilisation that grants us an "Encyclopedia Galactica" containing all its cosmic wisdom. His wife sometimes teases Loeb that he is, in fact, an extraterrestrial, mistakenly left on Earth: "She only asks that I leave the car keys when they return to take me back to my home planet." I asked Loeb how he maintains an interest in Earthly intrigues: American politics, the raging pandemic, widespread civil unrest. He counters quickly. Of all areas of research that he has pursued, the search for extraterrestrial life is the most intertwined with the fate of this planet. He believes that our failure to detect intelligent beings suggests one of two things. It could be that our species is the product of a one-in-a-trillion fluke and we really are alone in the universe. Or it might be that civilisations are short-lived phenomena that die out before they're capable of exploring the galaxies and making themselves known to others.

"Like most scientists, I would love there to be convincing evidence of alien life, but this isn't it"

If 'Oumuamua is a lightsail, the second of these two options is more plausible. This errant object would be evidence not of some thriving intergalactic civilisation just beyond our solar system, but a relic of a long-extinguished one. That, in turn, implies that intelligence is a perilous thing and that a civilisation's technological

Loeb sometimes wonders whether resistance to his lightsail hypothesis is driven by our unconscious desire not to grapple with a fear of humanity's impending doom. To stave off nihilism, he prefers to see 'Oumuamua as a warning, pointing to the folly of our environmental destruction. "Right now here on Earth it feels like we are headed towards a kind of disaster," he said. "Something like 'Oumuamua could teach us an important lesson to get our act together."

It requires a cosmic humility to recognise a signal from another intelligence. Loeb thinks we have yet to acquire that as a species. We are collectively held back by a kind of infantile narcissism that reminds him of his daughters. As young children they believed they were the most important beings in the world. That illusion was shattered when they arrived at kindergarten and other classmates received more attention than them. "They suddenly realised that they were not the centre of the world or even the smartest kid on the block," he said. "Maybe it is time for us to do the same?"

Oscar Schwartz is a writer based in Melbourne

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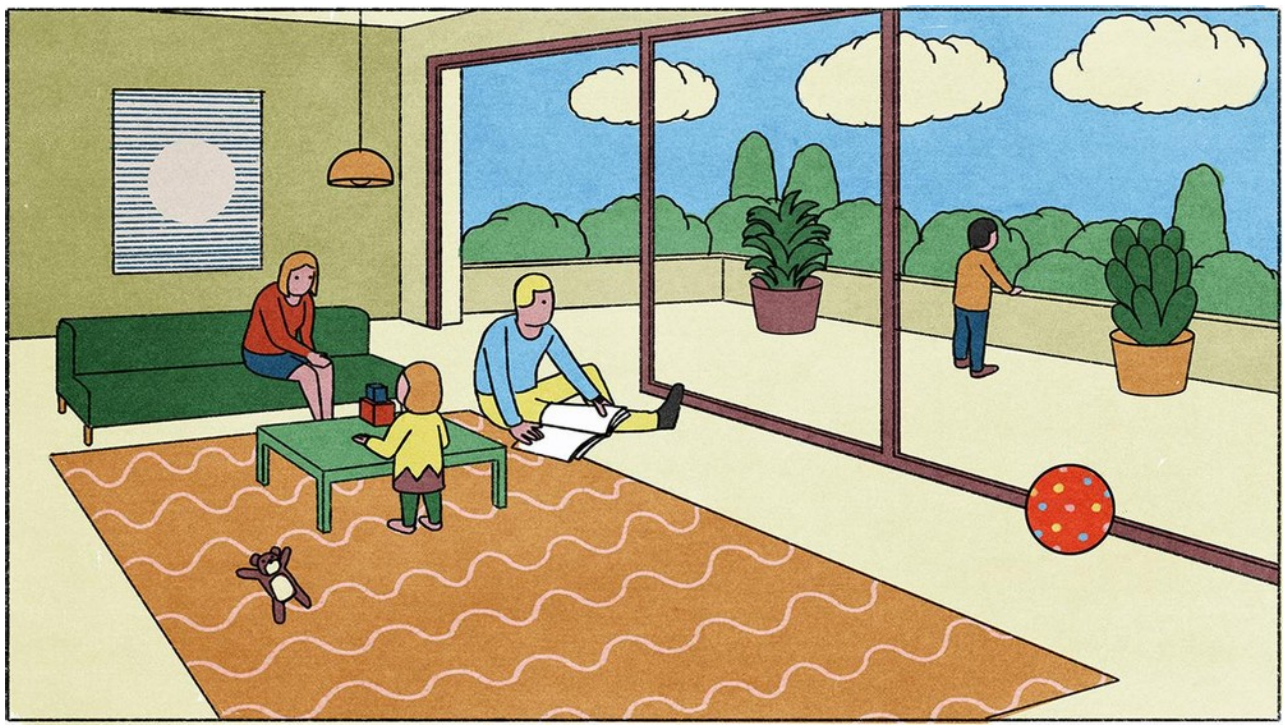

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