Number 49 | March 2022

EdgeScience

Current Research and Insights

Astronomical Anomalies and Extraterrestrial Life

Those Mysterious Murmurations

Reflections on Death

A publication of the
SOCIETY FOR
SCIENTIFIC EXPLORATION

SOCIETY FOR SCIENTIFIC EXPLORATION

EdgeScience #49
March 2022

EdgeScience is a quarterly magazine.
Print copies are available from edgescience.magcloud.com.
For further information, see edgescience.org.
Email: edgescience@scientificexploration.org

Why EdgeScience? Because, contrary to public perception, scientific knowledge is still full of unknowns. What remains to be discovered—what we don't know—very likely dwarfs what we do know. And what we think we know may not be entirely correct or fully understood. Anomalies, which researchers tend to sweep under the rug, should be actively pursued as clues to potential breakthroughs and new directions in science.

PUBLISHER: The Society for Scientific Exploration
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DESIGN: Smythtype Design

The Society for Scientific Exploration (SSE) is a professional organization of scientists and scholars who study unusual and unexplained phenomena. The primary goal of the Society is to provide a professional forum for presentations, criticism, and debate concerning topics which are for various reasons ignored or studied inadequately within mainstream science. A secondary goal is to promote improved understanding of those factors that unnecessarily limit the scope of scientific inquiry, such as sociological constraints, restrictive world views, hidden theoretical assumptions, and the temptation to convert prevailing theory into prevailing dogma. Topics under investigation cover a wide spectrum. At one end are apparent anomalies in well established disciplines. At the other, we find paradoxical phenomena that belong to no established discipline and therefore may offer the greatest potential for scientific advancement and the expansion of human knowledge. The SSE was founded in 1982 and has approximately 800 members in 45 countries worldwide. The Society also publishes the peer-reviewed *Journal of Scientific Exploration,* and holds annual meetings in the U.S. and biennial meetings in Europe. Associate and student memberships are available to the public. To join the Society, or for more information, visit the website at scientificexploration.org.

ISSN 2330-4545 (Print)
ISSN 2330-4553 (Online)

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Cover image: A pulsar known as B1509 imaged by NASA's Chandra X-ray Observatory.
Credit: NASA/CXC/SAO/P.Slane, et al.

Stephon Alexander

Escape from the Jungle of No Imagination

Into blinding darkness enter
Those who worship ignorance
Into as if still greater darkness
Enter those who delight in knowledge
— *The Upanishads*

Often when I am stuck on a problem—of the physics variety or the personal one—I make a pilgrimage to the northern coast of my birthplace, Trinidad and Tobago. There is something that feels unspeakably out of body about trekking through the lush sixty-mile stretch of the deep green mountain range overlooking Las Cuevas Bay. I hike up the winding paths to the top of a hill overlooking the ocean, the tropical jungle sounds looming behind me and the rhythmic crashing of the crystalline emerald crescent waves sounding below. Surrounded by nature, beautiful and primordial, I am often surprised to find new insights into my problems.

One day not so long ago, I found myself getting nowhere on a research problem. I headed back to the jungle to look at the sea. While I was there it dawned on me—not the solution to the research problem, but the realization that during two decades of scientific research, I had been unconsciously dodging my original reason for becoming a physicist: to make a meaningful scientific discovery. I realized I feared failure and the professional risk failure entailed. The ability to maintain a scientific career is driven by, among other factors, your reputation among your peers and familiarity with your work. Penalties await those who are perceived as a "crackpot" or who speculate too much. I knew that some of the ideas that interested me, such as the connection between consciousness and quantum mechanics, would make me vulnerable to stigma and potentially stump my career.

In theoretical physics research, there is a sense of dissatisfaction, a belief that we have not been able to break new ground in the same way that led to the quantum and relativity revolutions early last century. It's not to say that people aren't trying to address their dissatisfactions; a handful of papers are posted every day on an online global archive of physics research called

The north coast of Trinidad.
Stephon Alexander

the Archives, and oftentimes these papers offer new approaches to unsolved mysteries. Despite this, there's not much feeling of progress. Why is this? Is it because these problems are too hard for us? Or is it that in the search for the truth, some scientists are afraid to look at uncharted or forbidden territories, afraid because there may be penalties, reputational and professional, for stepping outside accepted paradigms? I think that it's the latter. I have decided to take some risks, hoping that we learn something significant along the way, whether I am right or wrong.

"We need to distinguish clearly between the values and norms that regulate scientific activity and those that demand conformity to a particular body of theory..."

As a Black physicist, this potential strength—that I am brimming with ideas, my capacity to generate speculative thinking—can be an impediment. Black persons in scientific circles are often met with skepticism about their intellectual capabilities, their ability to "think like a physicist." Consequently, my exploratory, personal style of theorizing, when coupled with my race, often creates situations where my white colleagues become suspicious and devalue my speculations. I have navigated a career in physics in spite of these racial and sociological prejudices, and, given both my personality and my predilections, I continue to march ahead, sharing my conjectures, which, at least sometimes, are theoretically fruitful.

During my time of self-reckoning in Trinidad, I decided to devote the majority of my research efforts to working on some of the big mysteries in physics. To do so effectively, I would have to bring my entire being to how I do physics, which meant engaging in improvisational and wild speculations. When you meet me in person, it is clear that I am volcanic with ideas, most of which turn out to be wrong, while some, even among those that are "wrong," are fruitful and worth pursuing. Underlying these ideas is a latent foundation, the theoretical and technical tools of my trade.

Physics is a social activity, and like all social activities it is regulated by norms. Practitioners are expected to conform to these normative expectations, and they are sanctioned negatively when they violate them. Too often the expectations of what it means to do "good science" become confused with specific theoretical orientations, which means that practitioners in subdisciplines are expected to uphold specific theoretical arguments. This is desirable insofar as it rules out ideas like flat-earthism and others that make no sense scientifically. Sometimes, however, this expectation of conformity stifles innovation and progress. Some scientists are reluctant to explore ideas outside the expected paradigm because they will be punished if they do so, which means that paradigm-shattering theories can be inhibited from emerging.

We need to distinguish clearly between the values and norms that regulate scientific activity and those that demand conformity to a particular body of theory, a particular paradigm, within a scientific community. Both are constituted socially, but the latter obligations can restrict our creativity, our ability to constitute new theoretical orientations. It is crucial, however, to recognize that our theoretical arguments must be regulated within and evaluated through the application of scientific values, the values of cognitive rationality. Very simply, this means that our theoretical arguments must be logically coherent and empirically warrantable. Not every "creative idea" may be turned into viable physical theory. In fact, the likelihood that any one of us will create a new paradigm because we have violated the norms regulating activity within the standard paradigm is very slim. No one can do so, however, without violating these norms.

I want my writing to serve as a source of inspiration and encouragement for individuals who feel disenfranchised and unwelcome in our scientific communities, people who are sometimes, or often, made to feel that they are not valued as contributors to the scientific endeavor. So as much as my new book is about my reflections on the state of physics, as theory, I also reflect on and analyze both the sociology of science and my own experiences to argue for the efficacy of outsiders' presence and perspectives in scientific communities and inquiry. The path to becoming a scientist poses challenges for everyone. In shedding new light on the social dynamics of science, and simply sharing our stories, we can see how some of the challenges outsiders face can inspire them to make significant scientific contributions. I hope to convince my readers that diversity in science is not simply a social justice concern, but that it enhances the quality of the science we accomplish.

Excerpted with permission from Fear of a Black Universe: An Outsider's Guide to the Future of Physics *by Stephon Alexander, Basic Books, 2021.*

STEPHON ALEXANDER is a professor of physics at Brown University and the 2020 president of the National Society of Black Physicists. He is a specialist in the field of string cosmology, where the physics of superstrings are applied to address longstanding questions in cosmology. In 2001, he co-invented the model of inflation based on higher dimensional hypersurfaces in string theory called D-Branes. In such models, the early universe emerged from the destruction of a higher dimensional D-brane which ignites a period of rapid expansion of space often referred to as cosmic inflation. Alexander is also a jazz musician and released his first electronic jazz album *Here Comes Now* with Erin Rioux and *God Particle* with bassist Melvin Gibbs. The author of *Jazz of Physics*, Alexander lives in Providence, Rhode Island.

Beatriz Villarroel and Geoff Marcy

Astronomical Anomalies:

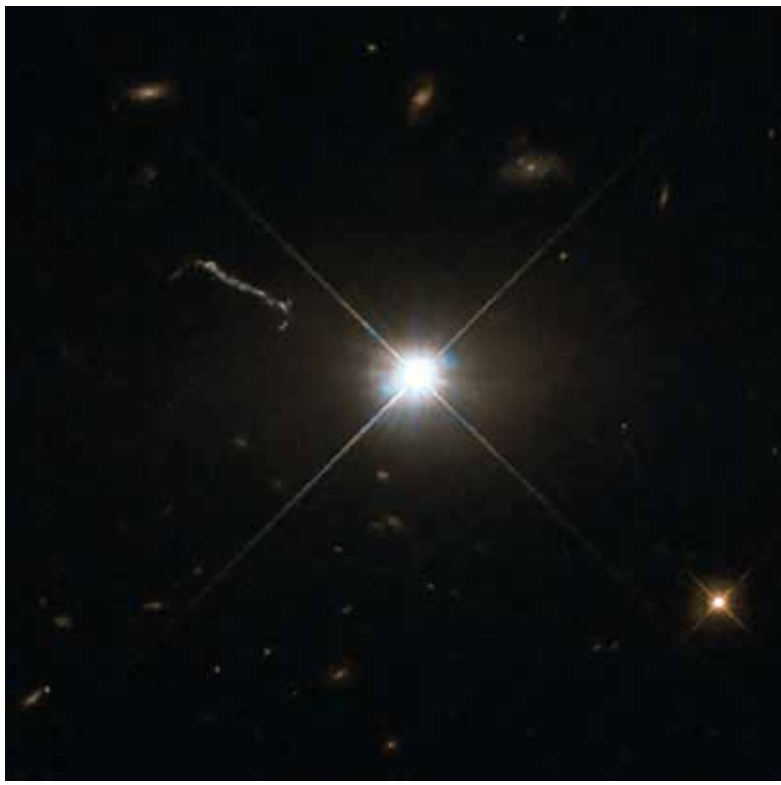
Their Role in the Quest for Extraterrestrial Life

The word "anomaly" is defined by the *Oxford English Dictionary* as "a thing, situation, etc. that is different from what is normal or expected." In the field of astronomy, an anomaly becomes the subject of detailed observations, studied with images, spectra, and light curves. Sometimes, once the anomaly has been discovered and published in a reputable peer-reviewed journal, fellow colleagues pick up on it and decide to perform their own analysis.

When Maarten Schmidt spotted a bright dot of light with a greatly Doppler shifted spectrum in 1963, the object was considered an anomaly. Within a few years, further observations showed these objects, now known as quasars, are actually outside our own Galaxy. Schmidt is credited with the discovery of the first quasar, known as 3c 273 (Schmidt, 1963). Twenty years later, astronomers realized that quasars are luminous galaxy cores powered by hot gas falling onto supermassive black holes. Astronomers have now cataloged millions of them. Observations show that super massive black holes exist at the centers of nearly all galaxies, all of which were "active galactic nuclei" in the past when accreting gas. Thus, we now have a complete turn-around: A galaxy that does not harbor a supermassive black hole and was never a quasar is now the anomaly.

History shows that an anomaly is at risk of being discarded as the result of a faulty analysis. Other times, the anomaly makes a comeback. The impact of sociological and psychological factors can influence its fate, as can the arrival of a resolution or its being forgotten.

One still unresolved anomaly is Halton Arp's famous discovery of *anomalous redshifts*, where pairs of galaxies showing bridges in between had different redshifts. According to the commonly accepted expanding universe model, the redshifts indicated vastly different distances, which would conflict with the apparent "bridge" between the two. Arp and others, including anti-Big Bang-proponents Margaret and Geoffrey Burbidge and Fred Hoyle, soon found many more examples of galaxies with anomalous redshifts, claiming that quasars tended to surround themselves with many more background and foreground objects than normal galaxies (Hoyle & Burbidge, 1996, Burbidge et al., 2003). These anomalous bridged but redshift-discrepant quasars challenged the notion that the redshift of a quasar can actually measure its distance from us. Thus, the Universe might not be expanding.



Quasar 3c 273 seen in the optical. ESA/Hubble & NASA

The object known as NGC 7603 shows a pair of galaxies connected by a bridge. The galaxies are located at two vastly different redshifts.
Sloan Digital Sky Survey

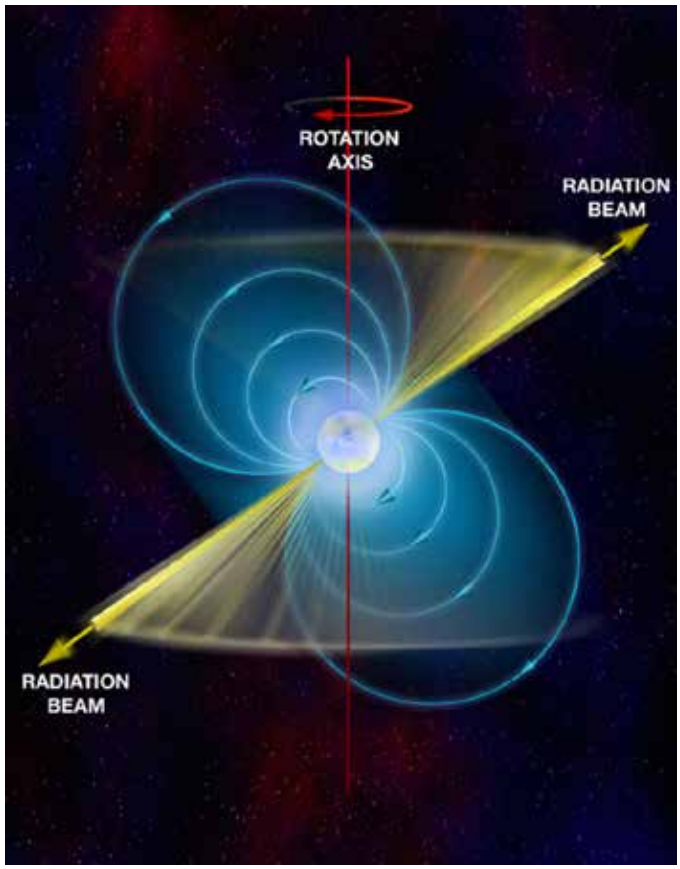
When the Armenian astronomer Victor Ambartsumian hypothesized that galaxies are actually splitting and giving birth one to another, rather than gravitationally colliding, Halton Arp proposed that quasars actually are newly born galaxies ejected from a galaxy core (obtaining a high redshift upon ejection), and thus could be found in alignment with other objects. After a few heated debates, the discussion of anomalous redshifts died off without a final resolution (López-Corredoira, 2010) even as the consensus has been to disregard the effects as due to poor statistical analysis. So an anomaly might be abandoned before it's even solved, simply because scientists find no meaningful resolution and grow tired of it!

Each subtopic of modern astronomical research has its own set of anomalies. Today, some of the most fascinating anomalies are those that relate to our searches for extraterrestrial life. Some of these anomalies have been thoroughly reported in the popular science media. The question of whether or not we humans are alone as a technological civilization is so intriguing to scientists and the public that even a remote possibility that an anomalous observation is caused by the activity or presence of "little green men" serves as a driving force to find an underlying explanation.

From Little Green Men to Exoplanets

In 1959, Giuseppe Cocconi and Philip Morrison published a seminal work, "Searching for Interstellar Communications," in the journal *Nature* where they speculated that just as we humans are unwittingly broadcasting our existence to our interstellar neighbors through radio waves, our interstellar neighbors may similarly be revealing their presence to us. When a young PhD student named Jocelyn Bell, one late summer in 1967 in rainy Cambridge, detected a mysterious repeating radio signal (Hewish et al., 1968) with a new telescope she herself had helped build, it was no surprise that she immediately alerted her advisor, Anthony Hewish. They found the radio waves arrived in pulses, each lasting a fraction of a second, followed by a pause of 1.3 seconds. The mysterious radio source came from a particular coordinate in the sky, which made it obvious that it did not come from our own Earth. What could this mysterious source be?

Soon after this signal was referred to as "Little Green Men-1" (LGM-1), and astronomers started considering the possibility of alien activity. This anomaly would have remained mysterious had not others been found, making it clear that pulsating objects are a natural phenomenon and abundant in the universe. Today, pulsars are understood to be dense, compact objects only a few tens of kilometers in size, with a strong magnetic field (up to a trillion Gauss), and that spin hundreds of times each second around their axis, emitting double beams of accelerated particles that we observe on and off as the object quickly rotates. These quizzical false-alarm little green men form at the end of the lives of massive stars, when they explode as supernovae only to collapse to a neutron star. Anthony Hewish went on to receive the Nobel Prize for the discovery in 1974, while Jocelyn Bell Burnell had to wait 44 more years to receive the nearly as prestigious Special Breakthrough Prize in Fundamental Physics in 2018.



Bill Saxton/NRAO/AUI/NSF

A sketch of the structure of a rotating pulsar that was initially anomalous but now serves as an accurate cosmic clock.

But that was not the end of the story with pulsars. Their regular pulses constitute accurate clocks and they sometimes come in orbiting pairs bound by gravity. So these "orbiting clocks" provide an excellent test of Einstein's theory that predicts the existence of gravitational waves. When one such pair was discovered, gravitational waves were demonstrated indirectly through the decrease of the orbital period of the system as the two neutron stars spiral toward each other. The pair of pulsars was losing energy through the emission of gravitational waves, as Einstein's theory predicted. Impressed by the agreement between the predictions and the observations (Weisberg et al., 1981, Taylor & Weisberg, 1982), the Swedish Royal Academy of Sciences decided to award a second Nobel Prize on pulsars, this time going to Russell Hulse and Joseph Taylor Jr.

At this point of the story, it would seem that pulsars had already given away all the secrets we need to know about the universe. But more would come. In 1992, Alexander Wolszczan and Dave Frail announced the discovery of the first exoplanet found outside the Solar System (Wolszczan & Frail, 1992). This was the confirmation that other star systems might form planets as well, not only those that formed around our own Sun. A few years later, the first three exoplanets around normal, hydrogen-burning stars were found by two competing teams, Michel Mayor and Didier Queloz (1995) and Geoffrey Marcy and Paul Butler (1996).

It was widely doubted that the first periodic Doppler shift

found around 51 Pegasi could be due to an actual planet, and for good reasons. The orbital period was anomalously short, only 4.3 days, much shorter than any "normal" planet in our Solar System. Also, the Doppler shift varied as a perfect sine wave, which is consistent with a star that was merely pulsating, breathing in and out. Such pulsations are well known to exist and constituted a less "anomalous" explanation than the existence of a "planet." However, the discovery of Doppler periodicity in the Sun-like star 70 Virginis was different. Its period of 117 days placed it at a distance comparable to Mercury's orbit Even better, the orbit was clearly eccentric, exactly as Newton's Laws predicted, making it unmistakably an orbiting planet rather than the pulsation of star (Marcy & Butler, 1996). 70 Virginis, along with 47 Ursae Majoris with its two-year orbital period, pointed to a high prevalence of planetary systems in a diversity of orbits, and many opportunities for life.

"An anomaly might be abandoned before it's even solved, simply because scientists find no meaningful resolution and grow tired of it!"

The Discovery of Fast Radio Bursts

About 15 years ago, two researchers at the Parkes Observatory were scanning archival data taken some years earlier with the radio telescope. In the data, they saw a short burst, lasting less than 5 milliseconds. The short burst was extremely powerful and came from a source outside our galaxy. A new anomaly in the radio wavelengths had been found. This first Fast Radio Burst (FRB) was discovered by Duncan Lorimer and his student David Narkevic (Lorimer et al., 2007). Today, we know of about 500 FRBs, some repeating themselves irregularly, a few regularly. The spacing between the pulses varies, and some can have periods as long as 18 minutes (see e.g. Hurley-Walker et al., 2022). The FRBs are emitted from a source with an extremely strong magnetic field. The origin of these bursts is heavily debated; they are thought to either be caused by very magnetized neutron stars or possibly by the merger of compact objects. It is difficult to build reliable theoretical models of these objects because these bursts are very short and difficult to localize in the radio spectrum. Last year some significant progress was made when a FRB inside our own Galaxy, FRB 200428, was localized by the Canadian Hydrogen Intensity Mapping Experiment (The CHIME/FRB Collaboration, 2020). The FRB was also emitting in the gamma and x-ray frequencies. The scientists proposed that the burst of light could be produced when the jet from a magnetar (a neutron star with an extremely strong magnetic field) collides with the surrounding interstellar medium and produces a shock wave.

But even here astronomers have not refrained from discussing alternative possibilities such as ET technology (Lingam & Loeb, 2017). The speculations on the possible ET origin of FRBs peaked at a time when a particular subcategory of FRBs was found and dubbed "perytons," radio bursts having pulses that were about 250 milliseconds in duration at the 1.4 GHz radio frequency (Burke-Spolaor et al., 2011). Was ET signaling to us via these very peculiar and sharp bursts? The mystery further deepened as researchers noticed that the bursts only appeared weekdays and during office hours. How clever—ET must already be familiar with our habits! More clues emerged until it was finally established that the perytons were caused by two microwave ovens at the observatory that emitted small bursts whenever the lunch goer opened the microwave door prematurely (Petroff et al., 2015)!

A Megastructure Around Boyajian's Star

Sometimes an anomaly is an error or an instrumental fluke, but in some cases the object actually has an anomalous behavior that might or might not be natural in its origin. An example is Boyajian's Star named after its discoverer Tabetha Boyajian (Boyajian et al. 2016). The object showed an unusual dimming. The discovery hit the headlines of all major media in 2016. Jason Wright et al (2016) described their extraordinary theory for the dimmings of the star this way: "KIC 846285 [is] an object with a bizarre light curve consistent with a 'swarm' of megastructures. We suggest that this is an outstanding SETI target."

The news media exaggerated this claim in hundreds of newspapers, blogs, podcasts, and documentaries, all highlighting megastructures built by alien super civilizations, with little mention of the heritage explanation: clumps of dust that could block a small fraction of Boyajian's star. The media seldom report the more conventional interpretations. It was well known since the 1940s that young Sun-like stars, called T Tauri stars, vary in brightness sporadically and unpredictably due to dust clouds around them that occasionally move in front of the star, blocking some of the star's light (Bertout, 1989). Indeed, stars somewhat older than our Sun also show brightness variations due to dust that hasn't gone away over the millions of years. Even our Sun still has some dust around it; it's called "Zodiacal dust" and it's the remains of collisions of asteroids that fragment into dust. But in the end, thanks to the large interest in the story, extensive measurements were made of its brightness at different wavelengths from blue to red to the infrared, which showed colors consistent with dust along the line of sight—and the anomaly of Boyajian's Star has gone away, for now.

There is Life in Venus Atmosphere

Even when the news reporting is more balanced, not every anomaly survives the test of time. One such example was the suggested discovery of life on Venus last year (Greaves et al.,

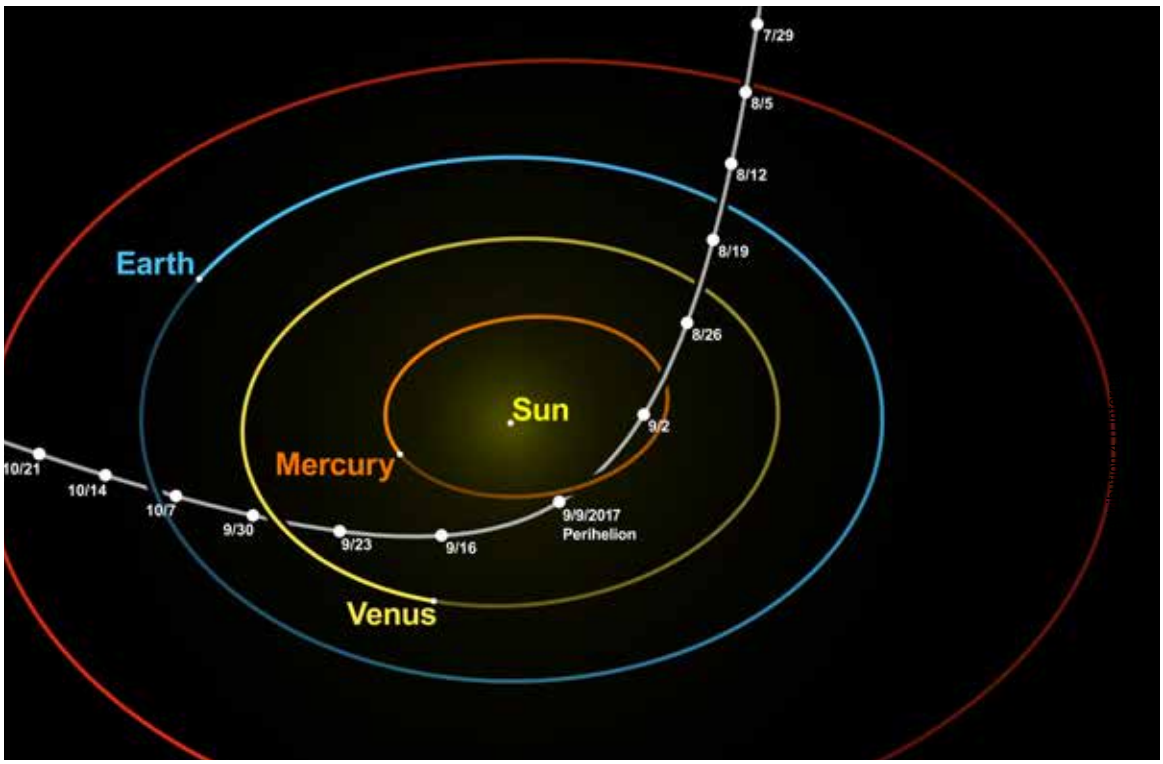
2021). The discovery was intriguing because we are unaware of any organisms that can survive in a climate as hot as Venus, which has a surface temperature of 475 C. The scientists had analyzed radio waves coming from Venus using the James Clerk Maxwell Telescope and Atacama Large Millimeter/submillimeter Array. They reported absorption of wavelengths at which phosphine absorbs radio waves, thus discovering the gas phosphine in the atmosphere of Venus. Theorists in a group headed by Sara Seager developed atmospheric and chemical models related to microbial life in a "Venusian Aerial Biosphere" (Seager et al., 2021), and their theoretical models predicted that phosphine could not possibly occur unless some microbial life form generated it. So they concluded that the discovery of phosphine constituted strong evidence for life in the atmosphere of Venus.

Doubts were soon raised, however. One was related to the measurement technique and the method used to identify and quantify the phosphine in the spectrum. Another was that even if the signal was real, the absorption could be caused by some other molecule. Indeed, sulfur dioxide absorbs at nearly the same wavelength (Lincowski et al., 2021). Life in the atmosphere of Venus also seems unlikely because the clouds are composed of sulfuric acid, and any descending organism would fall onto the cauldron of the surface. Even if the signal truly came from phosphine, non-biological origins remain possible, including volcanism (Truong & Lunine, 2021, Bains et al., 2022). Three follow-up observations, including at radio and infrared wavelengths, failed to find phosphine (Snellen et al., 2020; Villanueva et al., 2021; Lincowski et al., 2021). In this case, we see that an interested community can help to quickly investigate the most intriguing claims. But even these latest results are subject to change as some recent indications suggest the presence of ammonia in droplets in Venus atmosphere, making the planet more habitable than previously thought. Not seldom, it takes years to reach a final conclusion and it may well be the case here as well. We must remain open to the possibility that the phosphine or life might still be detected on Venus.

An Alien Spaceship Inside the Solar System

The most heated anomaly since Halton Arp's discrepant redshifts may be 'Oumuamua, which was discovered in 2017 as a point of light moving through the night sky. It entered our Solar System from outside, and then exited, never to return. It was the first object ever discovered to enter our Solar System from outside. It passed through unexpectedly and too quickly to allow careful observations, leaving its properties poorly measured (Meech et al., 2017; Ćuk, 2018; Raymond et al., 2018; Jewitt & Luu, 2019; Moro-Martin 2019). Although first thought to be comet, it had no cometary tail, and unlike other comets showed no carbon-based molecules or dust (Trilling et al., 2018). Extensive observations showed that its speed was too great to remain bound to the Sun (JPL, 2017).

A debate about its nature took off. Asteroids and comets are commonly "sling-shot" by gravity as they pass near planets, often achieving escape velocity from their home planetary system. As planetary systems are common around stars, our Milky Way Galaxy must contain millions of billions (> 10^{15})



Trajectory of 'Oumuamua through the inner parts of the Solar System in 2017, dated weekly.

of these wandering rocky escapees, some of which will pass through our Solar System by chance. Thus, 'Oumuamua has a natural explanation, albeit with some observational properties that remain unresolved (e.g. Jewitt et al., 2017; Meech et al., 2017; Luu et al., 2019; Moro-Martin, 2019).

But the natural explanation was not shared by all scientists. Shmuel Bialy and Abraham Loeb (2018) proposed that 'Oumuamua is a spacecraft with a light sail constructed by an advanced civilization. The light sail would be thin, less than a millimeter in thickness, and large enough to allow the object to be pushed by the reflection of sunlight. The extra push on the motion of the comet could be explained with a light sail. This suggestion gained international attention. But many scientists dismiss this spacecraft explanation, given the existence of possible natural explanations.

There is certainly a common "bias" against the spacecraft explanation for 'Oumuamua among scientists. The bias has several origins. First, we humans have never detected technological artifacts in the Galaxy, constituting an "absence of evidence" of alien life despite a century of telescopic observations. Second, the spacecraft explanation attracts too much media attention, which makes some scientists uncomfortable. Third, dogmatic ideas are as prevalent in the scientific community as in any other human endeavor (López-Corredoira & Castro Perelman, 2008).

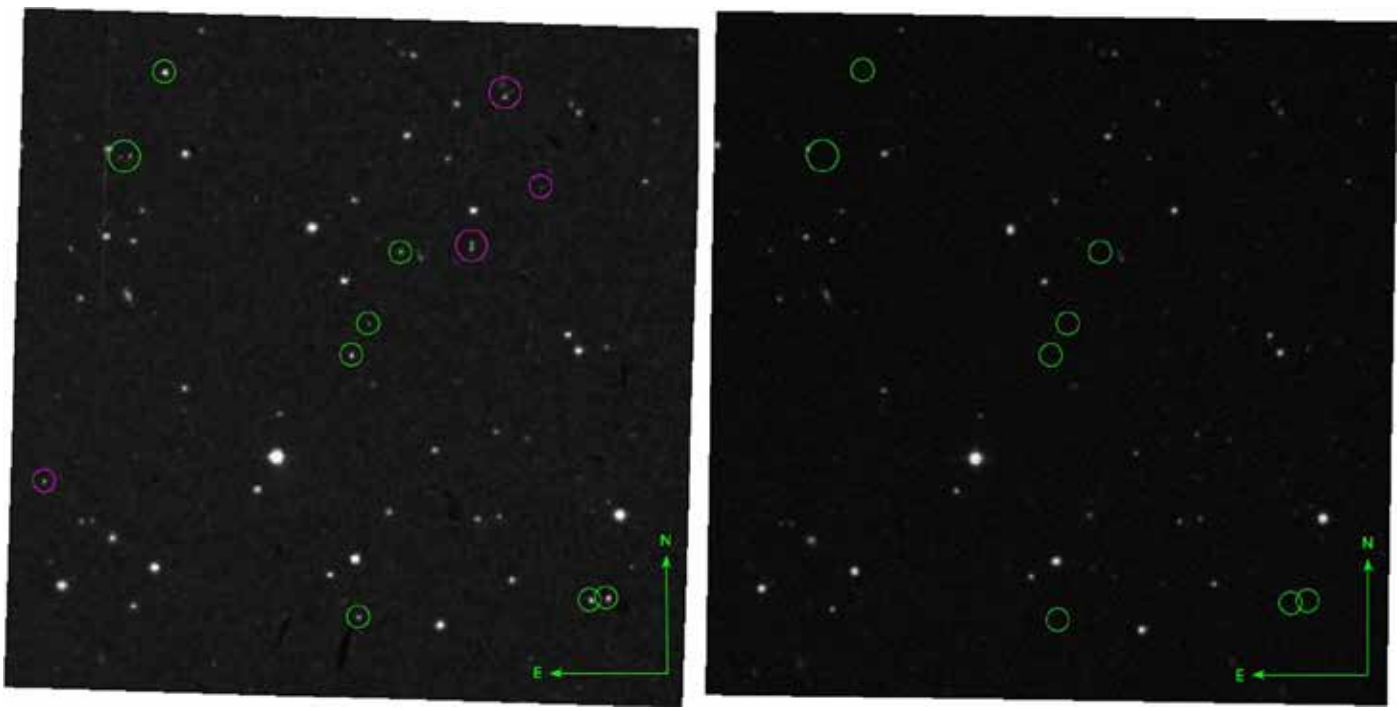
But the spacecraft theory of 'Oumuamua deserves an assessment of our bias against it. Suppose we had prior information about the prevalence of technological civilizations in our Galaxy, such as observations of radio or laser beacons detected from many directions. Such information might change our "prior" assumptions about the possibility of spacecraft and light sails, functional or not. The relative probability that 'Oumuamua is of natural versus technological origin depends on our prior information, motivating caution about our "gut feeling."

> **"Nature tends to surprise us continuously with new phenomena..."**

In September 2020, another interstellar visitor with similar properties as 'Oumuamua was detected, named 2020 SO. This visitor lacked any signs of outgassing. It turned out to be a rocket booster from a 1966 mission to the Moon.

Searching for "Vanishing Stars" with the VASCO Project

So far we have seen examples of serendipitous discoveries of anomalies. But one can also search for anomalies deliberately. An example of a project that aims to find weird astrophysical transients in the sky is the Vanishing & Appearing Sources during a Century of Observations (VASCO) project. The project proposal made the case for looking for "vanishing stars" and "impossible effects" in an attempt to find (1) signs of massive,



Beatriz Villarroel/Scientific Reports

Nine simultaneous transients. The green circles show nine star-like objects seen in a red photographic plate image of the sky taken on April 12, 1950 (left) but not in an image of the same patch of the sky taken 1996 (right). (Purple circles are artifacts during the scanning process.) Comparisons with other plates show that these objects appear and vanish within the exposure time of the plate, thus "simultaneously."]

evolved stars that fail to emit a bright supernova as they collapse to a black hole, (2) the activity of extraterrestrial intelligence in action through, for example, interstellar beacons, and (3) new, speculative phenomena like wormholes (Villarroel et al., 2016). From its inception, the project took on the goal of comparing historical images of the sky in the 1950s with modern sky imagery from Pan-STARRS observatory. An example of a transient visible in the old Palomar images is the object 1084-0241525 in the USNO-B1.0 catalog. Deep new observations with the 2.5m Nordic Optical Telescope in the Canary Islands eventually revealed a counterpart to the star, suggesting that the object was something that flared up momentarily in the old images. Soon, the VASCO project found about a hundred short-lived transients that were visible point sources in the old Palomar images but not to be seen in PanSTARRS data. Most of these are thought to be natural transients, such as flaring stars, optical counterparts to gamma-ray bursts, and similar phenomena. A list of such short-lived transients can even be useful in searches for communication lasers (Villarroel et al., 2020) that also would leave bright, short-lived spots in an image.

Last year, an unusual discovery of nine simultaneously appearing and vanishing star-like objects in a small image—a small fraction of a square degree in the sky—was announced (Villarroel, Marcy, Geier et al., 2021). An image taken half an hour earlier, and another image taken six days later, had no transients in the spots, suggesting that they appeared and vanished within the exposure time of the plate. No astrophysical scenario could be reconciled with this finding. A number of tests for instrumental artifacts also failed, revealing nothing dubious about the nine spots. Finally, the authors proposed that the "nine simultaneous transients" could be some "unknown" type of photographic plate contamination (defects) that produced eerily star-like shapes of varying intensities. But they also mentioned the possibility of having found a new phenomenon on the sky. One possibility discussed was reflections from highly reflective and flat objects in orbits around the Earth. To test this idea further, the VASCO team recently proposed how to look for solar reflections from objects in pre-satellite images (Villarroel et al., 2022) by looking for images where multiple transients follow a line. In this case, whether one finds support for the hypothesis or not, the result will be valuable for studies of possible alien artifacts in orbit around the Earth and to estimate an upper limit of such hypothetical objects. But a solution to the simultaneous transients might be neither plate defects nor alien artifacts. Nature tends to surprise us continuously with new phenomena, and maybe also here, the explanation might be rooted in physics presently unknown to us.

Progress and Possibility

The discovery of anomalies offers progress in astronomy through discrepancies with expectations, curiosity, and debate. In particular, what could be referred to as the "little green men possibility" gives researchers the extra push needed to spark human imagination and a desire to gather observations. Many scientists quote the loss of "credibility" of a certain field when big claims of alien life are made to the media. On the other hand, we have shown with several examples how research activity is often stimulated by the possibility of discovering alien life, regardless of the outcome.

BEATRIZ VILLARROEL is a postdoctoral researcher at the Nordic Institute of Theoretical Physics in Stockholm and IAC Tenerife. She obtained her PhD in 2017 from Uppsala University in Sweden. Her research focus is on Active Galactic Nuclei and searches for vanishing objects. She is the project leader of the Vanishing & Appearing Sources during a Century of Observations (VASCO) project that searches for astronomical anomalies with survey data. Beatriz likes playing violin in her free time.

GEOFF MARCY is one of the pioneers in exoplanets. His team found 70 of the first 100 exoplanets ever discovered, including the first planet in a Newtonian, eccentric orbit, proving they were actually orbiting planets. They found the first planets of Saturn-mass and Neptune-mass. Working with the NASA Kepler team they found the first Earth-size planets. Working with Erik Petigura and Andrew Howard, they found that 20 percent of Sun-like stars harbor an Earth-size planet in the habitable zone.

REFERENCES

Bains, W. et al., 2022, *Universe*, 8, 54

Bertout, C. et al., 1989, "T Tauri Stars: Wild as Dust," *Annual Reviews*, 27, 351

Bialy, S. and Loeb, A. 2018, *ApJL*, 868, L1

Boyajian,T.S. et al. 2016, "Planet Hunters IX. KIC 8462852 – where's the flux?" *MNRAS*, 457, 3988

Burbidge, G. & Hoyle, F., 1996, *Astronomy & Astrophysics*, 309, 335

Burbidge, E.M., Burbidge, G., Arp, H.C., Zibetti, S., *The Astrophysical Journal*, 591, 690

Burke-Spolaor S., Bailes M., Ekers R., Macquart J., Crawford F., 2011, *ApJ*, 727, 18

Cocconi, G. & Morrison, P., 1959, *Nature*, 184, 844

Ćuk, M. 2018, *ApJL*, 852, L15

Flekkoy, E.G. and Brodin, J.F. 2022, *ApJL*, 925, 11

Greaves, J.S., Richards, A.M.S., Bains, W. et al., 2021, "Phosphine gas in the cloud decks of Venus," *Nat Astron* 5, 655–664

Greaves, J.S., Richards, A.M.S., Bains,W. et al., 2021, "Recovery of Spectra of Phosphine in Venus' Clouds," https://arxiv.org/pdf/2104.09285.pdf
Hewish, A., Bell, S.J., Pilkington, J.D.H., Scott, P.F. & Collins, R.A., 1968, *Nature*, 217, 709
Hurley-Walker, N., Zhang, X., Bahramian, A., McSweeney, S.J., O'Doherty, T.N., Hancock, P.J., Morgan, J.S., Anderson, G.E., Heald, G.H. & Galvin, T.J., *Nature*, 601, 526
Jewitt, D., Luu, J., Rajagopal, J., et al. 2017, *ApJL*, 850, L36
Jewitt, D., & Luu, J. 2019, *ApJL*, 886, L29
JPL Small-Body Database Browser: 'Oumuamua (A/2017 U1). *JPL Small-Body Database*. Jet Propulsion Laboratory. JPL 1 (Solution date: 2017-Oct-24). JPL 10 (Solution date: 2017-Nov-03)
Lincowski, A.P., Meadows,V.S., Crisp,D., Akins,A.B., Schwieterman, E.W., Arney, G.N., Wong, M., Steffes, P.G., P.Niki Parenteau, Domagal-Goldman, S., 2021, *ApJ*, 908, L44
Lingam, M. & Loeb, A., 2017, *The Astrophysical Journal Letters*, 837, L23
Loeb, A., 2021, *Review for Astrobiology*, arXiv: 2110.15213
López-Corredoira, M. & Gutiérrez (2002), *A&A Letters*, 390, L15
López Corredoira, M. & Castro Perelman, Eds., 2008, *Against the Tide. A Critical Review by Scientists of How Physics and Astronomy Gets Done*. Universal Publishers, Boca Raton
López-Corredoira, M., 2010, *Evolution of Cosmic Objects through their Physical Activity, Proceedings of the Conference dedicated to Viktor Ambartsumian's 100th anniversary*, held 15-18 Sep 2008 in Yerevan and Byurakan, Armenia, Editors: H.A. Harutyunian, A.M. Mickaelian & Y. Terzian, Yerevan, "Gitutyun" Publishing House of NAS RA, p. 196–205
Lorimer, D.R., Bailes, M., McLaughlin, M.A., Narkevic, D.J. & Crawford, F., 2007, *Science*, 318, 777
Luu, J. X., Xiao-Ping, & Jewitt, D. 2019, *ApJ*, 158, 22
Marcy, G. and Butler, R.P. 1996, *ApJ*, 464, L147
Mayor, M, and Queloz, D. 1995, *Nature*, 378, 355
Meech, K. J., Weryk, R., Micheli, M., et al. 2017, *Nature*, 552, 378
Moro-Martín, A. 2019, *AJ*, 157, 86
Petroff, E. et al., 2015, *Monthly Notices of the Royal Astronomical Society*, 451, 3933
Raymond, S.N., Armitage, P.J., Veras, D., Quintana, E.V., & Barclay, T. 2018, *MNRAS*, 476, 3031
Seager, S., Petkowski, J.J., Gao, P., et al. 2021, "The Venusian Lower Atmosphere Haze as a Depot for Desiccated Microbial Life: A Proposed Life Cycle for Persistence of the Venusian Aerial Biosphere," *Astrobiology*, V.21, 1206-1223. https://www.liebertpub.com/doi/10.1089/ast.2020.2244
Snellen, I.A.G., Guzman-Ramirez, L., Hogerheijde, M.R. et al., 2020, "Re-analysis of the 267 GHz ALMA observations of Venus: No statistically significant detection of Phosphine," *Astron. & Astrophys*, 644, L2
Taylor, J. H. & Weisberg, J. M. 1982, "A new test of general relativity—Gravitational radiation and the binary pulsar PSR 1913+16," *Astrophysical Journal*. 253: 908–920.
Truong, N., Lunine, J.I., 2021, *Proc. Natl. Acad. Sci. U.S.A.*, 118, e2021689118
The CHIME/FRB Collaboration, 2020, *Nature*, 587, 54
Trilling, D.E., Mommert, M., Hora, J.L. et al. 2018, *The Astrophysical Journal*, 156, 261
Villanueva, G.L., Cordiner, M., Irwin, P.G.J. et al. 2021, "No evidence of phosphine in the atmosphere of Venus from independent analyses," *Nat Astron* 5, 631–635
Villarroel B., Imaz I., & Bergstedt J., 2016, *Astronomical Journal*, 152, 76
Villarroel, B., Mattsson, L., Guergouri, H., Solano, E., Geier, S., Dom, O.M., Ward, M.J., 2022, *Acta Astronautica*, 194, 106
Villarroel, B., Marcy, G., Geier, S. et al. 2021, "Exploring nine simultaneously occurring transients on April 12th 1950," *Nature*, 11, 12794
Villarroel, B. et al. 2020 "The vanishing and appearing sources during a century of observations project. I. USNO objects missing in modern sky surveys and follow-up observations of a 'Missing Star.'" *Astronom. J.* 159, 8
Weisberg, J. M.; Taylor, J. H.; Fowler, L.A., 1981, "Gravitational waves from an orbiting pulsar," *Scientific American*. 245 (4): 74–82
Wolszczan, A. & Frail, D.A., 1992, *Nature*, 355, 145
Wright, J.T. and Sigurdsson, S. 2016, arXiv: "Families of Plausible Solutions to the Puzzle of Boyajian's Star," *arXiv*, https://arxiv.org/pdf/1609.03505.pdf
Wright, J. T., Cartier, K.M.S., Zhao, M., Jontof-Hutter, D. and Ford, E. B. 2016, "The Search for Extraterrestrial Civilizations with Large Energy Supplies. IV. The Signatures and Information Content of Transiting Megastructures" *The Astrophysical Journal*, 816, 17
Schmidt, M. (1963), *Nature*, 197, 1040

The authors wish to thank Martin J. Ward for helpful discussions.

In the next issue of the *Journal of Scientific Exploration*

Articles in the Spring 2022 issue, which is the first by the journal's new editor, **James Houran**, include:

Toward a New Theory of Earth Crustal Displacement by Mark Carlotto

Scrutinizing the Relationship Between Subjective Anomalous Experiences and Psychotic Symptoms by Álex Escolà-Gascón & Jordi Rusiñol Estragues

Isotope Ratios and Chemical Analysis of the 1957 Brazilian Ubatuba Fragment by Robert M. Powell, Michael D. Swords, Mark Rodeghier, & Phyllis Budinger

Do the 'Valentine's Day Blues' Exist? A Legacy Report on a Purported Psychological Phenomenon by Rense Lange, Ilona Jerabek, & Neil Dagnall

The Badlands Guardian: A Human Portrait with Feathered Headdress by George J. Haas, William R. Saunders, James Miller, Michael Dale, & Keith Morgan

Imants Barušs

Reflections on Writing about Death

maginima/iStock

In my background research for writing a book about death from a scientific perspective—including discussions about deathbed phenomena, after-death communication, mediumship, instrumental transcommunication, anomalous physical phenomena such as poltergeist activity and possession, near-death experiences, past-life experiences, and the nature of the afterlife—there are several things that I have noticed that I think are important to point out.

At the outset, I want to note the volume of books that are available from trade book publishers asserting the existence of life after death. So, for instance, there are books written by someone who has had a near-death experience, or someone whose deceased son appears to be communicating through a medium, or someone who ostensibly talks to the dead by recording the noise from radios tuned between stations. Often the authors have been thrust into these situations without having sought them out. And, usually, although not always, they are unaware of the relevant academic literature and have no training in research design nor the interpretation of empirical data. Of course, that is not their fault. Their experiences were never part of a scientific inquiry but, in some cases, were subsequently reconceptualized as evidence for life after death. And so, there are bound to be problems. In particular, what I have noticed, is that non-experts frequently assume that the occurrence of any anomalous event, such as a medium providing correct information or a radio that is still working in spite of having had its vacuum tubes removed, is prima facie evidence for the persistence of the personality after the death of the physical body. Of course, that is not a logical inference.

The problem is compounded by the fact that academics, with a few exceptions, have simply avoided this subject matter. That is not surprising. The academy is still predominantly saturated with materialist ideology, whereby survival of death is regarded as being impossible. So there is no point to survival research. Here are three skeptical arguments: (1) It has been argued that those who are sympathetic to the possibility of survival should not be doing survival research because they are biased in favor of survival. (2) There is a correspondence between specific neural networks and human behavior. As the underlying physiological substrate is damaged, such as in dementia, the cognitive abilities subsumed by that substrate are lost. Therefore, consciousness is dependent on the proper functioning of the brain and cannot survive the deterioration of the brain. (3) For near-death experiences with temporal anchors, whereby experiencers correctly identify events that occurred at a time when their brains were not functioning in the manner that is necessary for such perception, the skeptical explanation is that the brain functions in mysterious ways that have yet to be discovered.

What is wrong with these arguments? Well, (1) true believers in materialism could also be biased and, in fact, sometimes state their purpose as that of reifying anomalous phenomena in conventional terms; (2) correlation does not imply causation; and (3) speculating that mysterious abilities of the brain will be found to explain anomalous perception is just promissory materialism and directly contradicts the neuroscientistic thesis that the appropriate functioning of known neural correlates is required for the production of subjective experience, which was the argument for the cessation of consciousness with physical death in the first place. With few exceptions, I find arguments by self-identified skeptics to be logically flawed and superficial, so they end up not being useful.

This discussion about skepticism opens up the theoretical question: How are we to understand poltergeists, past-lives, the sense of presence, and so on? I find there are three main positions, which I refer to as materialist, living agent psi (LAP), and survival. The materialist explanation is an explanation in conventional terms, such as those endorsed by many self-identified skeptics. In other words, we have misperceptions, misrememberings, errors in documentation, cognitive or psychosocial nonconscious processes, mental illness, fraud, and so on as explanations of phenomena. For instance, hearing snippets of voices in the static created by radios tuned between stations is probably just pareidolia, the psychological tendency to find meaningful structure in ambiguous stimuli. LAP, previously known as super-psi, attributes phenomena of interest to remote viewing and remote influencing by experiencers. For instance, a medium gets correct information about someone who is deceased. Is this just a medium with good remote viewing skills, able to extract that information from wherever it can be found? Survival refers to the survival of consciousness after death. There is usually an added assumption that any such

surviving disembodied consciousness has the same constitution as the embodied consciousness, for instance, by retaining a person's memories, sense of identity, motivations, and so on. So, someone who was interested in playing hockey while alive remembers after death that they were playing hockey and continues to have such an interest. That assumption is usually just implicitly held without critical examination.

We can think of materialism, LAP, and survival as consecutive positions clockwise from left to right on a dial. Given the data that we have from the various phenomena, how far can we move the dial clockwise, toward survival? To give some idea of the difficulty that we run into, we can consider a modern version of Plato's analogy of the cave from *The Republic*. Suppose that we live in a room with a television set. We have never been out of the room. We are watching a hockey game on the television set. Because we have never been outside the room, we are convinced that the hockey game is in the television set. We can prove this by removing a resistor and a diode here and there and watching the image on the monitor degrade. We can put a disc of a hockey game into our disc player and thereby prove that there does not even need to be an outside world. We can identify the activity of the electronic circuits in the television that correspond to taking a shot on net, and so on. Clearly the television is the source of the hockey game. Of course, it is not. There really is a hockey game being played outside the room, but we have no way of proving that. For every permutation of the image, we can speculate about a way in which the television set itself created that. That is what we are up against. We are alive. We are not dead. That presents an epistemological problem. All of our evidence is evidence within the domain of the living, not the domain of the deceased, whatever that might be, yet we want to use it as evidence of activity among the deceased. But we can always come up with speculative ways to explain what is happening by reference to the living.

Modern Mechanix and Inventions, October 1933

In 1933 Thomas Edison's "ghost trap" invited spirits to insert themselves into a light beam directed at a photoelectric cell.

If we proceed as scientists, then what are we doing? We are evaluating theories against the evidence for them. A theory is unconstrained if there is insufficient evidence to favor one theory over another. When a boy dreams about an airplane crash, is that the result of a previous life-time in which he crashed in an airplane or because of the video about airplanes that he watched over and over again (Sudduth, 2021)? In a way, science is an inherently contrived activity. We need to find circumstances in which conditions are such that we can test the differences between our theories. Or, better, yet, we want to have control over the relevant variables ourselves and create circumstances in which we can tease apart the different theories. This is the point of the Large Hadron Collider for testing theories of subatomic physics, for example.

How does that translate to the context of death? How about inviting spirits to insert themselves into a light beam directed at a photoelectric cell, as Thomas Edison did (Edison's own secret spirit experiments, 1933), or requesting spirits to bring their "hands" up to the sides of a box containing a plasma globe, to affect the plasma filaments inside it, as Gary Schwartz has done in his research at the University of Arizona (Schwartz, 2021). Alas, when it comes to death, experiments are rare. What we have instead are stories. We can relabel those stories as "case studies" or "field investigations," but that is not going to please those who demand to see laboratory experiments before they are willing to accept any new information. But here is something important about science. Science is relentless in the pursuit of truth and will proceed with whatever techniques are available to advance understanding, however imperfect they might be. So, we have stories. Do we have stories with good documentation about events in naturally occurring "contrived" circumstances so that we can discriminate between theories and move our scientific exploration forward?

The answer is yes. I think that the stories about so-called veridical near-death experiences can distinguish between explanations and move the dial to the right. For instance, in a case discussed by cardiac surgeon Lloyd Rudy Jr., Rudy's patient was pronounced dead during cardiac surgery. The cardiac surgeons left the operating theatre to inform the man's wife. They returned later and stood in a doorway with arms folded discussing the case. Somebody had forgotten to turn off the heart monitors, so there was paper piling up on the floor. After some 20 to 25 minutes without a pulse and, hence, no brain activity sufficient to support consciousness, the surgeons noticed a promising signal in the paper record that became a heartbeat and resuscitated their patient. Upon recovery several days later, the patient apparently correctly described the appearance of the operating theatre and events that had occurred at the time he was supposed to be dead, including the perception of the surgeons standing in the doorway with their arms crossed (Barušs & Mossbridge, 2017).

First, this is a situation that the experiencers had not anticipated. This was not a prospective, scientific study. Such studies have been attempted by setting targets near the ceiling in hospital rooms for patients to look at while they are having a near-death experience but, to date, no one has reported perceiving any of those deliberate targets. What we have are memories of what a patient said and memories of what the conditions were in the operating theatre that he was ostensibly describing. These are memories by two cardiac surgeons who agree about the details as described here. Second, we have ostensibly veridical perception by a patient lying on an operating table. This moves the dial toward LAP. Third, we have something more. The image of the two cardiac surgeons standing with arms folded in a doorway is a temporal anchor. It sets the timing of the patient's remote viewing to the period when there was no heart activity and, hence, no brain activity of the sort that is required for perceptual experiences. The implication is that the patient was able to "see" without a functioning brain. And, if so, then what exactly is the nature of the consciousness that does that seeing? Can we move the needle toward survival?

There is something else that we need to take into account. The accuracy of remote viewing appears not to fall off with temporal displacement, so the veridical perception in this case need not have taken place at the time that the patient was in the operating theatre, but could have occurred upon subsequent recovery when the brain was working again. In fact, those who have had a near-death experience frequently have anomalous abilities turned on by the near-death experience, including precognition, the "Pauli effect," whereby mechanical devices fail in their presence, and the "reverse Pauli effect," which appears to give experiencers the ability to heal other people, electronic devices, and so on. We have no information about whether this patient's anomalous abilities were turned on by the near-death experience and, if so, whether he made the observations in the operating theatre using retrocognition, but ascribed them to the time of their occurrence. It is a possibility.

Anomalous events such as these can be denied, not because of the quality of the evidence, but because they exceed a reader's boggle threshold. Another significant theme, which can be challenging, is the extent to which physical stuff moves around by itself. I mean macro-pk. Bells that ring by themselves. Mist from a vaporizer that takes the shapes of recognizable faces. Computers that display meaningful words by themselves. Dead radios that start playing music. A radio with its vacuum tubes removed that continues to broadcast recognizable speech. Flowers at a funeral that leave their container and smash to the floor. A book that disappears and then, after an extensive search, reappears in the place where it was supposed to be in the first place. Stones flying through the air around corners. A woman sitting in a chair who has levitated and who witnesses are hard-pressed to push back to the chair. A crystal that dematerializes when investigators try to pick it up. Oh, and micro-PK: a random event generator that deviates from random behavior when "being 7" is being channeled by a medium. Such suspension of Newton's laws of motion is so prevalent in all aspects of the phenomena associated with death that it needs to be carefully considered.

This does raise another issue in trying to move from LAP to survival. The idea is that some of the anomalous violations of Newton's laws are the result of interference by discarnate entities. But how are they going to exercise their influence? It would seem that is going to be through the same mechanisms

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as LAP, namely, remote viewing and influencing. So the question can be reframed from LAP or survival to LAP by whom? Who is the agent? Is the agent alive or dead? Is it LAP or DAP, dead agent psi? To give another example: Suppose someone were to come to me and start describing poltergeist phenomena. I might ask whether when she comes home from school, the lipstick on the top of her dresser has been nicely lined up in a row while she was gone. Yes, she says. The point is that frequently there appears to be agency with some degree of intelligence that is manipulating the physical stuff. In the computer text case, it appeared to be a student's grandmother writing meaningful messages to her family (Barušs, 2013). For Schwartz, it is an "I'm Not a Robot" task to which answers are given by unseen entities by bringing their "hands" up to the sides of his box. The point of using the "I'm Not a Robot" task is precisely to determine whether the dead agents are intelligent.

So, where does the dial end up? What I have noticed is that it is not so much the impact of explicit arguments that I am making for one theory in preference to another that is convincing, but that, upon writing story after story, there is a slowly dawning realization that the room with the hockey game is simply too small to encompass all of the phenomena that we need to accommodate. We are asking so much of our available living agents that there is no way that they can be the source of all of the anomalies. This is a variation on philosopher Stephen Braude's argument from crippling complexity to prefer survival to LAP (Braude, 2003). It becomes clear that physical manifestation is just a thin veneer of a much greater reality that is psychological in nature. And that unseen, greater, psychological reality keeps stirring the physical veneer (Barušs, 2021). Note that we have privileged the left side of the dial over the right side, and have seen whether the dial can move clockwise from materialism to survival. Conversely, had we privileged the right side of the dial in our investigation, then perhaps the dial would never have had reason to move counterclockwise toward materialism at all and we would simply have accepted survival. In either case, the idea that presents itself is that all that death does is release the mesmerizing hold of the physical veneer on the consciousness of the psyche so that it can drift into the greater reality that lies underneath.

Acknowledgements

I thank Monika Mandoki and Karalee Kothe for critical feedback about this paper. I thank Shannon Foskett, my research assistant, for critical feedback, editorial assistance, and proofreading in the preparation of this paper. And I thank King's University College for a paid sabbatical leave and for an internal research grant that has given me the opportunity and resources to write a book about death.

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REFERENCES

Barušs, I. (2013). *The Impossible Happens: A Scientist's Personal Discovery of the Extraordinary Nature of Reality*. Alresford, Hampshire, UK: John Hunt Publishing.

Barušs, I. (2021). *Radical Transformation: The Unexpected Interplay of Consciousness and Reality*. Exeter, UK: Imprint Academic.

Barušs, I. & Mossbridge, J. (2017). *Transcendent Mind: Rethinking the Science of Consciousness*. Washington, DC: American Psychological Association.

Braude, S. E. (2003). *Immortal Remains: The Evidence for Life After Death*. Lanham, MD: Rowman & Littlefield.

"Edison's Own Secret Spirit Experiments" (1933). *Modern Mechanix and Inventions*, October, pp. 34–36.

Schwartz, G. E. (2021). "A computer-automated, multi-center, multi-blinded, randomized control trial evaluating hypothesized spirit presence and communication," *Explore*, 17, 351–359.

Sudduth, M. (2021). "The James Leininger Case Re-examined," *Journal of Scientific Exploration*, 35(4), 933–1026.

‘BACKSCATTER’

Lyrysa Smith

Those Mysterious Murmurations: Of Starlings…and Humans?

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Some murmurations have been counted in numbers of millions of individual birds. Many murmurations carry on long after the threat (usually a falcon or hawk) has passed; they can last 45 minutes or more.

A murmuration is unforgettable. A dark, shape-shifting cloud made up of thousands of starlings, fluidly flying in instantaneous collective maneuvers. The birds swirl, twist, and mold into huge, swooping, shifting, semi-solid shapes in the sky and connect immediately to join and move as one organism. Without an obvious leader or guide, their rapid, synchronized motion seems to be something unlike anything humans can do, or is it?

The flashing, flowing patterns of starlings’ murmurations have spurred wonder and curiosity for generations. Why do the birds do it, and how? The ancient Romans thought murmurations were messages from their Gods. Today, most experts believe that starlings form murmurations for safety in numbers. A predator, such as a peregrine falcon, struggles to pick off one individual in a coordinated mass of whirling birds unfolding shapes in the sky. Some also say the birds generate warmth with flying and being close to each other before roosting together for the night.

Less clear is how in the world they do it. No collisions. No clipped wings. Immaculate ballet in the sky. How do thousands of birds coordinate complex, integrated, pulsating forms while flying? Scientists have tried to pin down this phenomenon for nearly a century.

Explanations

As early as the 1930s, ornithologist Edmund Selous suggested that birds “must think collectively, all at the same time.” In his book, *Thought Transference (or What?) in Birds*,[1] he states that the concerted, beneficial action of groups of birds can only be explained by silent “thought transference” between individuals and amongst the flock. He believed that starlings use an innate type of telepathy to transmit their flying intentions in a murmuration.

In the 1950s, scientists postulated that birds (and fish and insects) moving in a group was simply a stunningly fast response to others in the group rather than an ability to mind-read or to follow a leader’s command. John T. Emlen, a zoologist and ornithologist, stated in *Flocking Behavior in Birds*,[2] that an attraction to a helpful feature in the environment, such as a food or water source, could lead to a rapid convergence of all the individual birds at a common physical place. He also stated that a “mutual attraction” between individual birds could lead to nearly immediate gatherings in a flock that appears to be globally coordinated.

By 2010, Andrea Cavagna, the research director for the Institute for Complex Systems in Rome, and her colleagues, published a study discussing their mathematical analysis and the physics of magnetism to describe murmuration.[3] They pinned their research on the notion that a “collective response [of a group of starlings] may yield a significant adaptive advantage.” The researchers suggested that each starling’s movement is influenced by every other starling. No matter how large a flock is, all of the individuals are connected to the same network, similar to how electrons move when nearby particles become magnetized. They proposed that “scale-free correlation” and synchronization were responsible for the birds’ coordinated movements. By far “the most surprising and exotic feature of bird flocks,” noted the researchers in their final discussion, was that special correlation between starlings does not decay with distance. They hoped that further study might someday contribute to the “fascinating collective mind” idea, and admitted “How starlings achieve such a strong correlation remains a mystery to us.”

This research and the ongoing mystery of murmuration led some to wonder if indeed the birds might share a group intelligence, and therefore, function as an integrated system that somehow goes beyond biology. Scientists have remained puzzled.

In 2013, George F. Young and Naomi Leonard, both from the Department of Mechanical and Aerospace Engineering at Princeton University, joined a group of physicists in Italy to study starlings’ murmurations using hundreds of photos drawn from several videos.[4] Beginning with Leonard’s notion that “in

a flock with 1,200 birds, not every bird will be able to keep track of the other 1,199 birds," the scientists' model identified seven as the optimal number for each bird to align with. Each bird needs only to keep track of six nearby birds in flight to balance between group cohesiveness and individual effort. With each little group of birds interacting with individuals and other groups of seven, the morphing spreads in split seconds and creates the continuous forms of a murmuration. Young stated that their study "demonstrates the significant role of who is interacting with whom in the ability of a network to efficiently manage uncertainty when seeking to maintain consensus."[4] Young concluded that their results provide an explanation for starlings using seven neighbors, but that further investigation is needed to discern other aspects of starlings' behavior to explain the responsiveness of starlings' murmuration.

In 2015, another group of physicists and biologists found in their study of networks of interaction of mobile animal groups that a sensory network amongst starlings showed certain individuals in the group were the most influential and predicted cascades of behavioral change at their moment of initiation.[5] Lead authors Sara Brin Rosenthal and Colin Twomey from Princeton University stated that the "rapid transmission of local behavioral response to neighbors" enables astonishing synchronicity, as in a murmuration. They concluded that an understanding of collective behavior in large groups can be achieved if the hidden pathways of communication are revealed.

It is well-known that most birds have much higher temporal resolution than humans do; they collect and process information much more quickly. Birds hear, see, and respond much faster to their environment than lumbering humans do. The 2013 and 2015 studies provide explanations for some aspects of starlings' rapid responses and actions during murmuration. Still, no one has been able to definitively determine how starlings are capable of such extraordinary collective responses.

My thoughts go back to Selous's view, and I wonder: Could "thought transference" of some type play a part in murmuration, perhaps in combination with other explanations? I am content to leave murmurations in some mystery and simply be mesmerized and intrigued. Yet, I question if any theory of murmuration can be completely accurate without allowing for some kind of psychic communication among the birds, enabling the flock to act as one for the benefit of all.

A recent experience left me believing that humans are also capable of a type of murmuration and that a collective consciousness was at work.

Like Starlings

The first sparks of the Marshall fire started on Thursday, December 30, 2021, about one and a half miles from where I live. It would become the most destructive fire in Colorado history, with more than 1,000 homes destroyed. My older sister and I live in South Boulder; Molly lives in an assisted living facility and I live in an apartment half a mile from her. It's a lovely walk on most days with views of Boulder's famous Flatiron foothills.

Unaware of what would happen the next day, I decided on Wednesday evening to visit my youngest sister and her family in Denver on Thursday. Gusty strong winds of 40-50 mph were predicted, and we joked that as long as I stayed away from 18-wheeler trucks, my low-profile Honda Civic would be fine. But I had no idea that my drive—one I've done countless times—would combine wind and fire and reveal the best natures of those caught in the path.

Initially, I was buffeted by strong gusts on U.S. 36, but felt happy to be on my way. I was one mile from the exit for the town of Superior when I noticed a grey plume on a grassy ridge to my right. Dread gripped my heart. Did fire officials know? I pulled over to the shoulder to call 911. In less than a minute, just as I'd put on my hazard flashers, the entire six-lane highway was blanketed in thick black smoke. I could barely see the taillights ahead. The cars all slowed and stopped. On my right, I saw a ridge of flames rushing like a flood of bright orange water over the hillside. It was over there—and then, it was nearly at the road's edge. So fast.

Instinctively, I began to move to the left, across the three lanes of traffic, with the intention of escaping the flames. I needed to rescue my sister and my two cats at home.

Somehow, as I approached the left emergency lane, to head in the opposite direction, back toward Boulder, dozens of other drivers around me in the dense smoke made the same decision in that moment. We began to turn an entire eastbound three-lane highway inside out. Like a murmuration of starlings, we maneuvered among each other as a unit, and allowed cars to merge smoothly and without competition. If any of us were to escape the flames now lapping at the edge of the highway, we would all need to escape. One by one, and as one, we rotated our cars and braided our three lanes into the far left lane, creeping toward safety—we hoped.

As we encountered the oncoming traffic from Boulder, they suddenly recognized the escape operation underway in

Lyrysa Smith

"I've just turned around to head west, and other cars are turning around and coordinating with me, so I took a moment to grab this shot."

front of them. Those of us closest to the flames and smoke needed more frequent stops to allow room for those still-eastbound vehicles—from sports cars to large trucks—to turn around and merge into the flow headed in the opposite direction.

No horns honked. No one yelled. We were patient, focused, and kind. I stopped for a tall van to turn and merge in front of me and pulled on the three masks I had in the car. Despite having my windows rolled up tight, the sheer power of the wind filled my car with smoke.

As I crept back toward Boulder along the concrete barrier that divides the highway, the winds were gusting east at 110 mph and flinging burning shrubs and flaming clumps of weeds through the air. The fire was just three lanes away, leaning in on the highway.

I realized that if one of the flaming, flying tumbleweeds came down or if the wall of flames began to cross the highway, I was driving a gas bomb, surrounded by similar gas bombs. I concocted a plan in which I would abandon my car, jump the concrete barrier, and run as fast as I could in the now-empty westbound lanes.

With one eye on the flames at the road's edge and the other on the seamless coordination of now hundreds of vehicles that had reversed direction and were slowly moving away from danger, I felt oddly confident that this flock of strangers was going to make this beautiful escape work, for one and all.

In my rearview mirror, I saw the flames beginning to jump the empty highway. Finally, I was able to exit using the entrance ramp in South Boulder. The cars on Table Mesa Road, which normally feeds that entrance ramp, were in reverse—amazing!—moving back so the escaping cars could exit.

I phoned Molly and learned she was with her friends and the facility was being evacuated. She was only vaguely aware of the bad fire. Once home, I prepared for possible evacuation, checked in on friends in the area, and told family that Molly and I were both okay.

That evening, I streamed the news on my laptop and saw many homes in Superior and Louisville engulfed by flames. I could see the fires on the horizon from my front door. They illuminated the night sky a burnt orange glow. I stayed on alert until the winds began to subside late at night.

Then, after midnight, it struck me. Hundreds of lives, including mine, could have been lost on U.S. 36, if not for the automatic understanding and remarkable collaboration of all the drivers. I don't understand how a group of strangers, human beings with their own interests and cares, driving on a three-lane, 65 mph highway, suddenly became so united in purpose.

No words spoken. No hand signals. No face-to-face communication. We all did it in dark black smoke, efficiently, safely, and compassionately. The power of silent, shared communication.

The next morning, the air was gray, putrid, and heavy. I was sad and grateful. My heart was broken for all the people and animals who suffered so much and lost their homes. A short while later, it finally began to snow.

Safe in my nest, no longer part of that procession of drivers, I still felt connected.

Reflections

It's believed that the primary reason starlings murmurate is to ward off danger. They fly as one to protect all. We humans on the highway were sensitive to signs and to each other that a potential danger was approaching, and we acted together, connecting silently. We synchronized and moved toward safety just as the fast approaching fire moved toward us.

Survival can often be achieved by an individual *for* that individual. But when each member of a group is equally threatened at the same time, can we collaborate to survive? Starlings do it. Can we humans be open and accept the unconscious communication that benefits us all? Silent connectivity is a higher form of engagement and sharing, where misunderstandings and miscommunication rarely occur. We listen, we feel, we act in unison. No collisions. No wings clipped.

Murmurations are a common and ageless way of coping for starlings. Can their synchrony inspire and remind us of our intrinsic connection to the world around us? Can we humans use our innate ability to cooperate as a murmuration in emergencies, or ongoing threats to body or environment, or simply to protect all life?

REFERENCES

1 Selous, Edmund. *Thought Transference (or What?) in Birds.* London: Constable and Co., Ltd.; 1931.

2 Emlen, JT. "Flocking behavior in birds," *The Auk.* 1952;69(2):160–170.

3 Cavagna A, Cimarelli A, Giardina I, Parisi G, Santagati R, Stefanini F, Viale M. "Scale-free correlations in starling flocks," *PNAS.* 2010;107(26):11865-11870. https://www.pnas.org/content/107/26/11865.full

4 Young GF, Scardovi L, Cavagna A, Giardina I, Leonard NE. "Starling flock networks manage uncertainty in consensus at low cost," *PLOS Computational Biology.* 2013;9(1): e1002894. https://doi.org/10.1371/journal.pcbi.1002894

5 Rosenthal SB, Twomey CR, Hartnett AT, Wu HS, Couzi ID. "Revealing the hidden networks of interaction in mobile animal groups allows prediction of complex behavioral contagion," *PNAS.* 2015;112(15):4690-4695. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4403201/

LYRYSA SMITH is an award-winning journalist and documentary filmmaker, a caregiver, and an author of *A Normal Life: A Sister's Odyssey Through Brain Injury.* She writes about science, health, everyday people, and nature. Her blog and website can be found at lyrysa-smith.com. Lyrysa is awed by birds wherever she finds them.

Garret Moddel

On "Hamlet: The Tragedy of a Parapsychologist" by Richard Reichbart. *EdgeScience* 48.

I would like to extend Richard Reichbart's excellent article in what will be for many an unexpected direction—but a direction that I believe is relevant to readers of *EdgeScience*.

The great Italian epic poet Torquato Tasso (1544–1595) was, during his lifetime, the most famous of European poets, and, I suspect, the role model for the character Hamlet. I am not the only person to think this: the Italian scholar Giampiero Giampieri is perhaps the first person unequivocally to argue this where others have merely noted "coincidental" parallels. Rather than fill valuable space with arguments along these lines, I would refer interested readers to my paper "Torquato Tasso as the inspiration for Shakespeare's Hamlet" posted to Academia.edu (and to be published in Italian by the Istituto di Cultura Torquato Tasso).

Why does this matter to readers of *EdgeScience*? Because of Tasso's bizarre psychology. He was tormented by poltergeist phenomena and destructive inner voices and sounds; he was often paranoid; he had visions, for example of the Virgin Mary. But in the context of Hamlet's ghost, Tasso would actually be visited by and converse with an unseen and unheard spirit being, to the incredulity of those who witnessed this. Indeed, Tasso's first biographer, the aristocrat Giovanni Battista Manso, was present on one such occasion and was dumbstruck by the elevated tone of Tasso's "replies" to an entity Manso could neither see nor hear.

But things get stranger. Tasso was the first modern to write an epic that bears comparison with the *Aeneid* and the *Iliad*: *Gerusalemme liberata*. The next great epic poem of European literature was Milton's *Paradise Lost*. When Milton was a young man he did a grand tour of Italy and actually sought out and befriended Manso—by now elderly—because of his famed patronage of Tasso. It is inconceivable that Manso did not tell Milton about Tasso's encounters with an intangible being. And when Milton eventually came to write his own epic he was blind and, as he describes in the poem, had it mostly declaimed to him in his sleep by an entity he termed his muse. He would then, on waking, dictate what he had received to his daughters, so that it could be written down. For instance, at the start of Book 7 we have Milton describing his muse taking him on transcendental journeys:

> Up led by thee
> Into the Heav'n of Heav'ns I have presum'd,
> An Earthlie Guest, and drawn Empyreal Aire,
> Thy tempring; with like safetie guided down [15]
> Return me to my Native Element:
>
> And a little later, when he is bemoaning his perilous state,
>
> In darkness, and with dangers compast round, [27]
> And solitude; yet not alone, while thou
> Visit'st my slumbers Nightly,

Or, at the start of Book 9, we have:

> If answerable style I can obtaine [20]
> Of my Celestial Patroness, who deignes
> Her nightly visitation unimplor'd,
> And dictates to me slumb'ring, or inspires
> Easie my unpremeditated Verse:

So we have two great epic poets both in apparent contact with spirit beings. But lest we think things are naively straightforward, it is worth noting that, once Milton's dictation had been written down, he would edit and shorten it. Why, if the celestial muse was superhumanly gifted, did the poet deem it necessary to cut her poetry back? Samuel Johnson in his essay on *Paradise Lost* asserted that "none ever wished it longer." If the great poet had not edited his muse, it would have been twice the length!

Jeremy Stafford-Deitsch
Cornwall, UK

On Letters: Why do I know more than I think I know?

I'd like to offer a bit of confirmation for the effect/phenomenon that Henry Bauer mentioned in the Letters section of *EdgeScience* issue 48. While I'm not in my golden years (I'm a mid-range GenXer), I've noticed something akin to the effect you describe happen to me for some time—perhaps since my mid to later 20s. It manifests irregularly and most typically with things of relatively little importance. One example is the use of a word that I'm almost certain I did not explicitly learn or look up but simply "appears" in my vocabulary. Another might be all of a sudden "knowing" the answer to a question on a subject that I don't believe I ever familiarized myself with. Occasionally it might manifest as knowing how to do something without spending time actually learning it; this has happened both in my career (software development) and manual skills. These events invariably cause a peculiar and distinctive kind of "surprise" response provoking an inner "How do I know this?" reaction.

Michael DeCarvalho

Henry Bauer replies:
For a possible explanation of my own experiences, I had been thinking in terms just of aging, but an alternative possibility is a mellowing, a relaxing, becoming a less driven personality that seems to have accompanied my aging. Does that ring any bells for you? Seem compatible with the chronology of your own experiences?

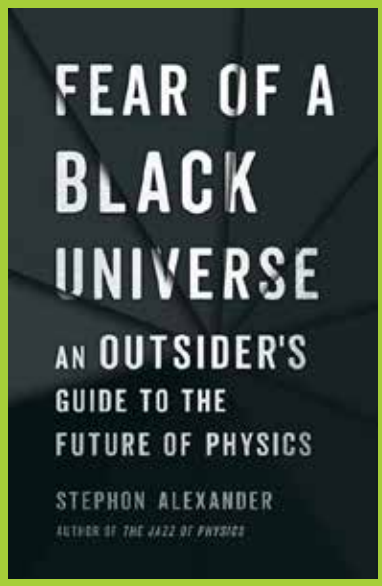
One of the occurrences that I've regarded as possibly a psychic episode was when I was in an artificially relaxed state, drunk but still able to function quite well: I had a short but significant winning streak by picking numbers at a roulette table: the then-ages of my two daughters. After several wins, there were gasps

from all around the table when I switched my bet to the sum of those ages, and that 1-in-36 chance also won. I then somehow felt, quite strongly, that the streak was over and I should stop playing. I didn't stop, of course, and lost some of my winnings.

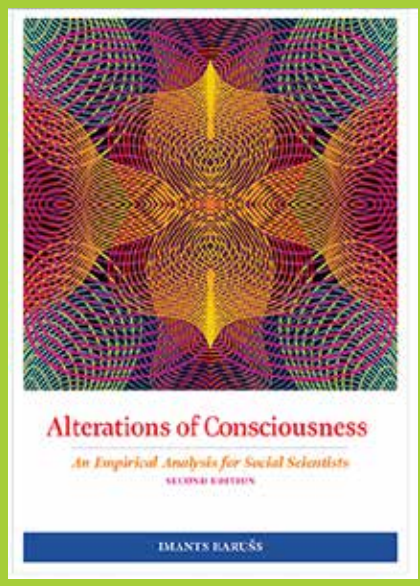
Some years later I asked Robert Jahn about possible psi experiments by putting the subjects in that sort of relaxed state, open to accepting whatever would happen. He pointed out that protocols for human-subject research required approval from committees, unlikely if it involved getting people drunk or drugging them.

But as individuals we could experiment, maybe using anti-anxiety medications?

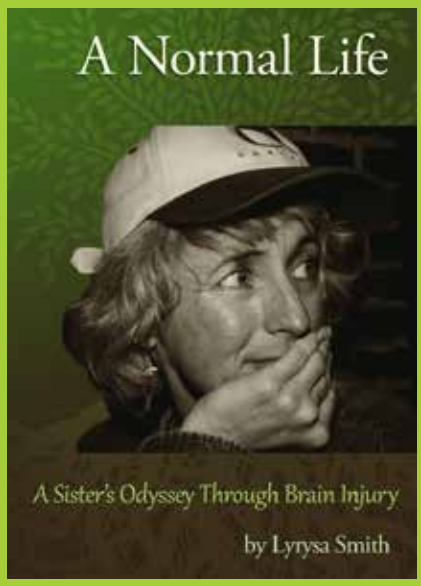
Noteworthy Books



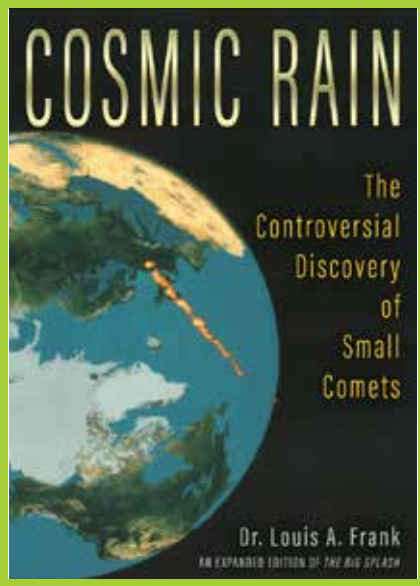
Fear of a Black Universe: An Outsider's Guide to the Future of Physics
by Stephon Alexander, Basic Books, 2021



Alterations of Consciousness: An Empirical Analysis for Social Scientists
By Imants Baruss, American Psychological Association, 2020



A Normal Life: A Sister's Odyssey Through Brain Injury
By Lyrysa Smith, CreateSpace, 2013



Comic Rain: The controversial Discovery of Small Comets
By Dr. Louis A. Frank, Anomlaist Books, 2021