CORNELL ASTRONOMICAL SOCIETY NEWSLETTER

ISSUE 3 • APRIL 2022

LETTER FROM THE TREASURER

Greetings our dear readers and star lovers! On behalf of our amazing team of writers and editors, welcome to the April (fools) issue of the Cornell Astronomical Society Newsletter! This month we present to you exclusive interviews with science experts and journalists, one of whom is a former CAS member himself! We also show you the inner workings of our very own solar telescope. Featuring creative pieces, we show the gift of the stories of constellations and take you for a walk on Enceladus in a snowstorm, saying goodbye to the snow and ushering in springtime!

Regarding CAS, we had our third public lecture on Friday, March 25, and will have our fourth and final lecture of the semester on Friday, April 15. Also, on April 12, we have the long-awaited Yuri's Night, celebrating the sixty-first anniversary of Yuri Gagarin becoming the first human in space. Keep an eye out for our emails with more details, coming to you in the next few weeks. Happy reading, and until next time!

Best,
Ariel Marxena
Treasurer, Cornell Astronomical Society

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INTERVIEW WITH NATALIE WOLCHOVER

BY ANNIKA DEUTSCH

Natalie Wolchover is a senior editor at *Quanta Magazine* covering the physical sciences. She writes on topics ranging from quantum computing to astrophysics. This semester she is the Zubrow Distinguished Visiting Journalist Fellow at Cornell, so she visited the campus for two weeks in March to meet with faculty, researchers, and students here at Cornell.

As a student-led organization with the goal of making astronomy more accessible to the general Cornell community and larger Ithaca community, we at the Cornell Astronomical Society were excited to sit down for an interview with her about her thoughts on science communication and her advice for undergraduates!

Natalie Wolchover
Credit: Quanta Magazine

This interview has been lightly edited for brevity.

AD: So to start off, very generally: Why do science communication?

NW: I think there's a lot of reasons to do science communication. I think it furthers societal progress for citizens to have access to information about science and understand the scientific process and how scientists come to the conclusions they do. So trying to bring all of that to life, I think, is really important.

I also think scientific progress is furthered by having clear explanations of developments at the forefront of different fields, both for helping a scientist in one discipline understand what's happening in another one, and make connections between them. So I think it can very much actually benefit science itself to have SciComm, even if this SciComm is aimed at non-scientists, it actually reaches a lot of scientists as well.

I also think it's just very enriching to people's lives to be able to follow advances at the forefront of astronomy and the rest of science. A lot of people don't get that much pleasure or stimulation out of their jobs, so it can be uplifting and provide people with a sense of greater meaning or at least a deeper understanding of our existence in some way. It's also enriching for our own lives, I think, as science communicators, to be following these advances and trying to really understand them holistically, and then turn what's happening into a digestible kind of story.

AD: Absolutely. Science nowadays is very specialized, so for scientists in other fields, it's helpful for them to be able to synthesize information coming from other areas. You write on a very wide range of topics. When you're writing about a complex subject, what do you do to make it accessible to a casual audience, as well as an audience of people who are not experts in that field?

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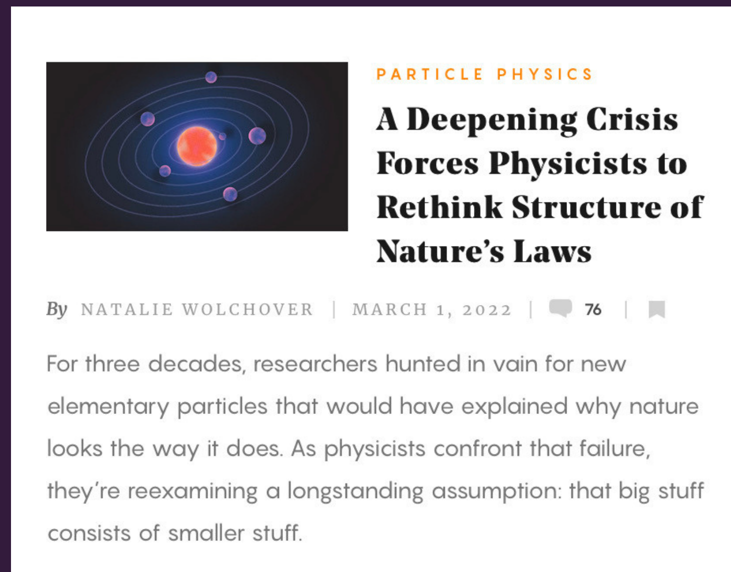
PARTICLE PHYSICS

A Deepening Crisis Forces Physicists to Rethink Structure of Nature's Laws

By NATALIE WOLCHOVER | MARCH 1, 2022 | 76

For three decades, researchers hunted in vain for new elementary particles that would have explained why nature looks the way it does. As physicists confront that failure, they're reexamining a longstanding assumption: that big stuff consists of smaller stuff.

Clipping from the cover of the most recently published article by Natalie Wolchover | Credit: [Quanta Magazine]

NW: So a key to all of this is doing a lot of interviews, talking to the scientists involved and building up an understanding of the research, just through conversations and follow up emails, and mining the scientists themselves for information. And doing enough interviews to where I feel like I'm gradually building up my picture of disagreement or different perspectives. Also, different scientists will have different ways of describing things. So, gradually, I come to understand the material to where then I can have my own conceptualization, that turns into a way of presenting it as clearly and as concisely as possible.

There's a lot that goes into figuring out how to describe things clearly and well. I think a lot of it is just putting the time in to take a rough explanation or paragraph and shorten it and tighten it up and make it more clear. I think in the end I don't worry too much that some of my readers are going to be lay people who have no knowledge of astronomy, say, and others will be astronomers, who have a lot of knowledge.

Ultimately, [the goal is] to say something clearly and well. The best explanation will be suitable for all of those audiences. Everyone can appreciate the same clarity and way of saying things.

AD: So you're talking about some of the ways you would approach writing about a topic, so that it could be understandable to a general audience. You once mentioned that often in science communication it's important to avoid the use of flowery language that you might find in other forms of writing. I was curious if you think there are any writing techniques that you must employ in science communication in order to do an effective job.

NW: Yeah. I think there can be very beautiful ways of writing about science; it doesn't have to be boring language, so I don't want to give that impression. But I think the scientific ideas themselves are so rich and interesting and hard to understand sometimes, basically that the language should not be distracting from the ideas themselves. It should be as plain and spare and straightforward as possible in order to just get the ideas across, rather than being too loud, or getting in the way of the ideas.

I think maybe that's a difference between science writing and other forms of it. It can be just a sort of plainness or straightforwardness or pursuit of clarity rather than the kind of interesting ambiguity that other kinds of writing often have.

In terms of what are the cardinal rules of science writing, you know—avoiding jargon, being succinct, since explanations are more digestible when they're shorter and asking less of the reader—I think those are some specific principles of science writing. I say this, but there's also a wide variety of forms of science writing and people approach it very differently as well. Maybe that's just how I see it—I don't want the writing to be distracting—it's just my own rule.

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AD: Absolutely! I'd say one example of [beautiful science writing] is, at the end of last year, you wrote an [article on the James Webb Space Telescope](). It was exciting to read, but it still provided a lot of clarity without over-complicating anything. I wanted to ask about that specifically because in a recent issue of the [CAS] newsletter I wrote about some of the instrumentation on Webb. One of my greatest difficulties was trying to take the technical language used to describe all of the instruments into language that could be more understandable, even to myself. So I'm curious to know what went into the decisions to talk about specific topics, like going back to Hubble, and also the writing style you chose to employ in that article?

NW: Yeah! Well, first of all, thank you; that's really nice of you to say that you'd read it, and enjoyed it. So, I think that article was really fun to work on because it did feel like such a grand and beautiful project, and the more I learned about it the more I realized what a powerful story it was, that people had been working so hard for so many years, or decades, at this point, to realize this incredible instrument. So I think part of the writing style was intended to convey that. To convey that this was a decade-long project, that had its roots in building on earlier telescopes, especially Hubble—that was also a decades-long project.

And I chose some people to talk about who were working on it themselves for many, many years; and in one case, a mother and daughter who were working on it, so this was sort of a generational project for them. Trying to convey the way science works as this long process of one thing building on the next was part of what I was going for. And how advances in technology and engineering relate to advances in our understanding of nature and the universe.

I also wanted to interweave the story of the telescope itself with the story of the scientific questions that it was built to help address in the fields that it will so greatly impact. So it's this very, very long piece that tries to weave these different things together, and also tries to convey the sense of majesty of this project. So along the way [I allowed] some more flourishes with the language because of that. Also, I did all of these interviews with these people who were so passionate and good at talking about their work, so also some of the vividness comes through in the quotes. They make what could otherwise be cold metal instruments come to life.

AD: I definitely agree. Just talking to people who are just so passionate, it makes you feel passionate about what they're doing as well. As a closing: what advice might you have for undergraduates who are interested in getting into science communication?

NW: My advice would be to read and write as much as possible. Read good journalism, especially science journalism. Think about what you like about it, and try to practice writing in a non-technical way, about anything. Just get the mechanics of writing, having ideas of what to write about, getting your mind working in that way.

AD: Certainly! Thank you very much for your time and for sitting down for this interview!

NW: My pleasure! Thank you for taking the time!

Natalie Wolchover speaking in Lewis Auditorium
Credit: Noël Heaney/Cornell University

FUERTES'S SOLAR TELESCOPE

BY BEN JACOBSON-BELL

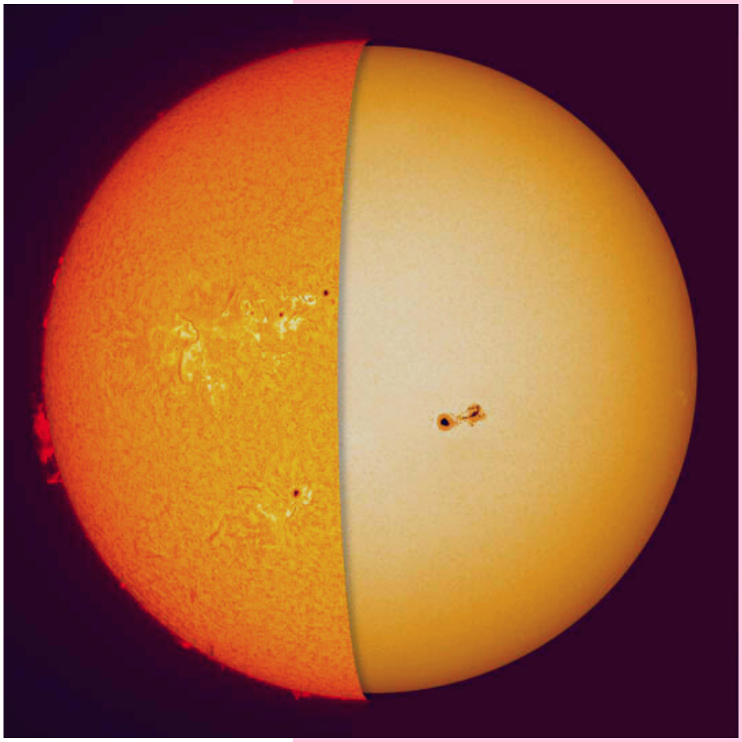
The night sky from Fuertes is beautiful, but not all stargazing happens at night—with the right filters, even the Sun can make a captivating sight! The Cornell Astronomical Society is fortunate to own a top-of-the-line solar telescope, which we bring out to the Fuertes deck, the Slope, or Central Campus on many a sunny day.

CAS member Annika with the solar scope on the Fuertes deck
Credit: Warrick Ma

HOW DO YOU OBSERVE THE SUN SAFELY?

Solar telescopes use a series of filters to block out all but the smallest fraction of light for viewing. A less common model is to allow the whole solar spectrum ("white light") to pass through the filters, displaying the Sun as a pale disk, perhaps with a few sunspots, exactly how it would appear if we were able to turn down its brightness.

Like most models, though, the Fuertes solar telescope uses specialized filters to block out most wavelengths of light almost perfectly, only letting through a sliver around 656 nm—known to physicists as the hydrogen-alpha (H-alpha or Hα) line—in which the bulk of solar features can be seen. With an Hα filter, we can see flares, prominences, and even surface activity over intervals of only a few minutes.



The Sun through an Hα filter (left) and white-light filter (right)
Credit: Alan Friedman

By stacking filters on top of each other, we can take the bandwidth of Fuertes's solar telescope down to just 0.5 Å, letting through a minuscule fraction of light and allowing us to eliminate an enormous amount of noise from the vicinity of the Hα line. With such precision, we can resolve prominences and surface features in stunning detail. As we head into spring and look forward to more sunny days in Ithaca, we hope to even start using the scope for solar astrophotography!

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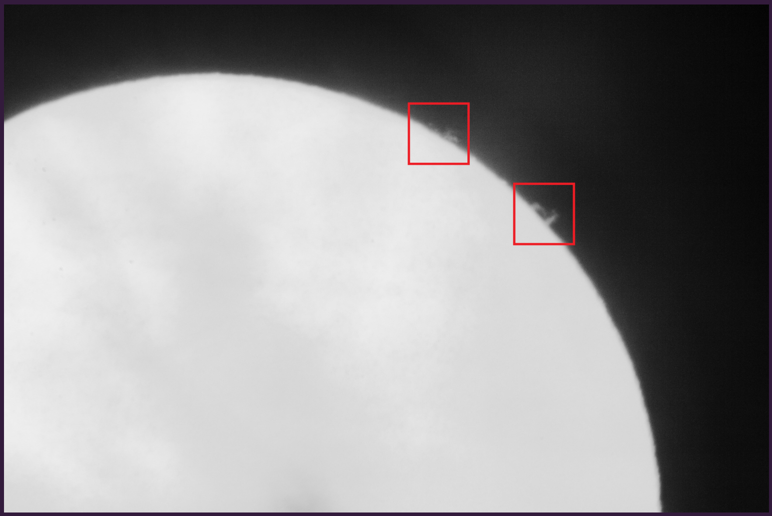
The emission spectrum of hydrogen, with the red Hα line farthest to the right. A Doppler shift would cause these lines to shift to the right or left (redder or bluer)
Credit: Jan Homann

Fun Fact: Most telescopes that use these specialized narrowband filters aim to center them as precisely as possible on the Hα line—656.28 ± 0.05 nm, in our scope's case. But most also have ways to tune the filters back and forth, capturing wavelengths in slightly different ranges, for an important reason: solar flares moving toward or away from us will be affected by Doppler shift—their wavelengths will no longer be on the Hα line!

Fuertes's solar telescope is a Coronado® 90mm SolarMax® III Series scope (not sponsored), a club purchase from spring 2021. It offers a breathtaking view into a lesser-explored area of amateur astronomy, one that we're thrilled to share with our members and the public. Through a telescope like this one, the Sun's true nature is revealed: it shines with our daily light and warmth, but it also stokes a fiery dynamism. It's not just our Sun, but a main-sequence star; a subject of study as compelling as any in the cosmos.



A photo of the Sun shot through Fuertes's solar scope. Note the prominences in the red boxes!
Credit: Warrick Ma

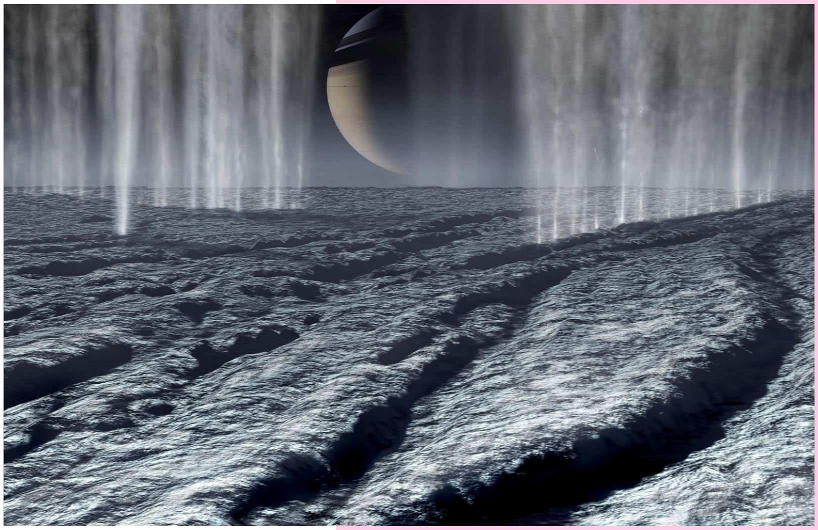
CAS member Warrick with the solar scope
Credit: Ben Jacobson-Bell

ENCELADUS

BY JUSTINE SINGLETON

Picture this: You are walking outside on a very snowy day. It's the kind of snow that you would rather stay inside for, but you can't. For whatever reason, classes or work or maybe some other obligation, you have to walk.

You need to hurry so you aren't late, but still move slowly enough that you don't slip. Wind, snow, and ice are a terrible combination. You waddle across the sidewalk, your puffy coat and layers of pants holding in your warmth like the pressurized suit of an astronaut. To make the commute just a little more bearable, you let your mind wander. You imagine that you really are an astronaut, and the glossy layer of white as far as the eye can see is really the surface of the Moon. No, not the Moon. There isn't any snow there, just dust. But maybe a moon. Enceladus.



Artist conception of Saturn through the plumes of Enceladus Credit: [Karl Kofoed]

In real life, you probably couldn't walk across Saturn's icy moon Enceladus like this, since it only has one percent of Earth's surface gravity, but this is only your imagination. You wonder if you would be able to see Saturn's rings from there. It would be a better view than the gray haze of clouds, that's for sure. Then you remember the geysers. Enceladus has jets of water, and it uses energy from its core to spray some of its icy particles into space. Several particles had formed one of Saturn's rings. Amazing how such a tiny moon and a little bit of ice could have such a large impact.

The stinging and biting of the cold have begun to reach your ears. You pull down on your hat, or earmuffs, or coat hood, or whatever you're wearing. It muffles your hearing slightly, but that doesn't matter. The only sounds are the howling of the wind and the crunching of your boots against the ice and slush and salt. You still have a long way to go before you arrive. If you lived on Enceladus, you wonder, would you already be at your destination? After all, the moon is about twenty-five times smaller than Earth.

Your mind wanders back to the geysers. Most of them are along four large lines down the bottom half of Enceladus. What were they called again? Right. Tiger stripes. Nobody knows exactly how they formed, but they are giant cracks in the tiny moon's icy surface, providing a window to the depths of the ocean beneath. At the south pole, where the tiger stripes are, the ice can be as thin as three miles.

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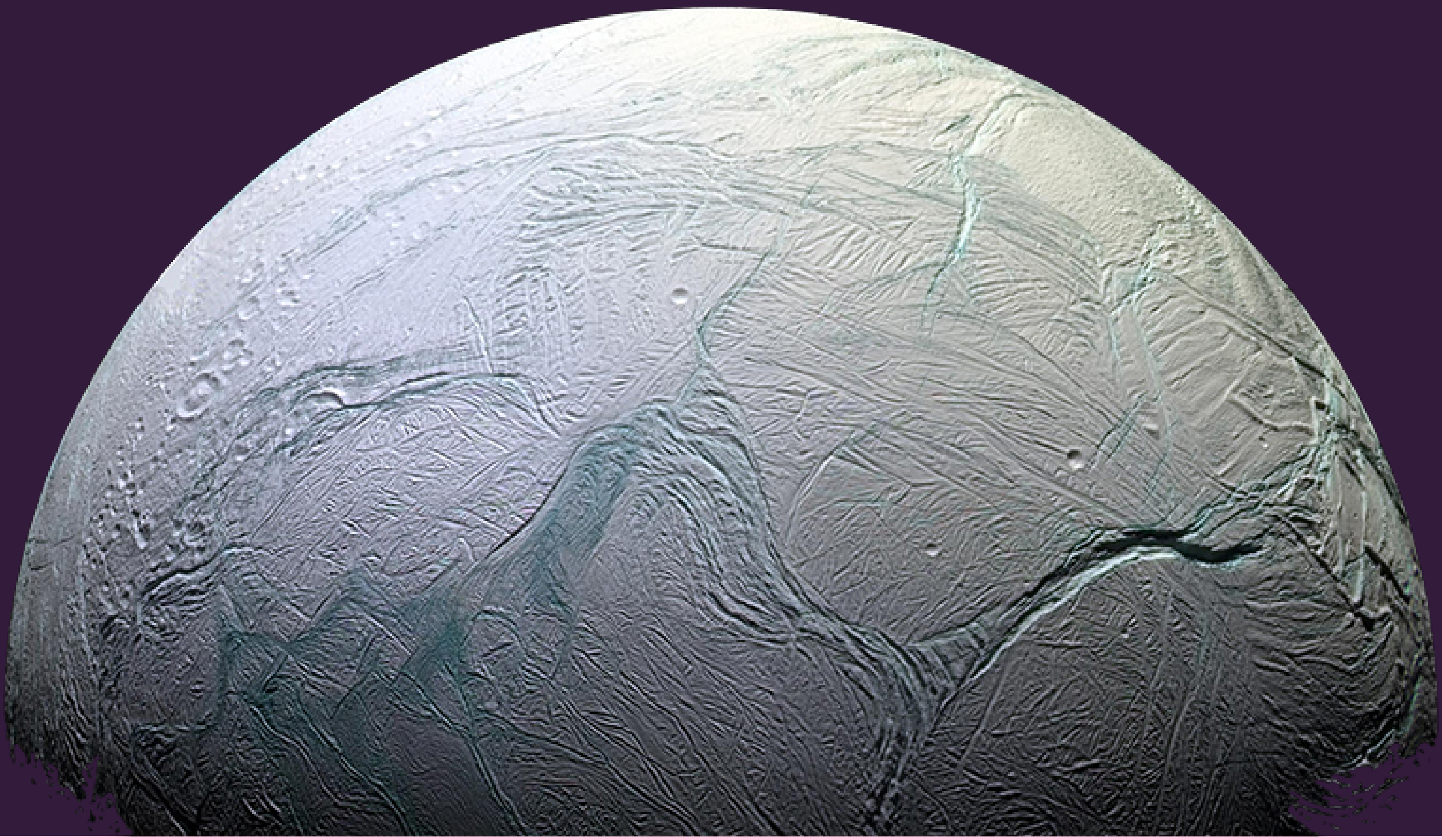
You think of standing on thin, broken ice, and walk just a little more carefully. It isn't so bad, you tell yourself. After all, there are places where the Earth's crust is just as thin. Still, you can't help but shiver, and not from the cold.

As you walk, you watch your breath turn to mist in the cold air. On Enceladus, you remember, the ocean beneath all the ice is warm. From what we can tell, it's heated by the core through hydrothermal vents to temperatures of at least 200°F. You imagine shedding your winter clothes and floating on the surface of a warm ocean. Almost-boiling water probably isn't ideal for that, but again, it is your imagination. There was salt in the Enceladan (or is it Enceladean?) ocean, wasn't there? Salt would make it easier to float. As if on cue, a gust of stinging cold wind blows into your face, snapping you back to reality. You continue walking.

Some wonder if there might be life in that ocean. You remember reading about the speculation. The hydrothermal vents, along with some of the molecules found in geyser spray, make a promising environment for organisms. You chuckle to yourself bitterly. If there were any, they would be lucky. *They* didn't have to go out into the cold.

In the distance, through the haze of the snow, you can see your destination. You trudge forward, putting both icy weather and icy moon behind you.



This month's space poetry and narrative come from CAS members!

VENUS

BY PEDRO DE OLIVEIRA

The Glance of all shades of brown,
A fiery ball soaked in sweet bark;
Better deserting to not drown,
As she slides in through the Olympus’s Arc.

The Glance, birthed at the fall of Troy,
Deceits a slow descent of an enfeebled field.
A beautiful hot breeze blundered by Bošković’s convoy;
At her pass-by, feverish astronomers keel.

The Glance, brighter than the shiniest celeste,
Shadows below the boiling forenoon Sun;
A brave sprout seeks her breasts at best,
Or eight years avail anyone.

But the bearing of deadly phosphine,
Depicts a love that stargazers have never seen.

GIFTS

BY MAGGIE LI

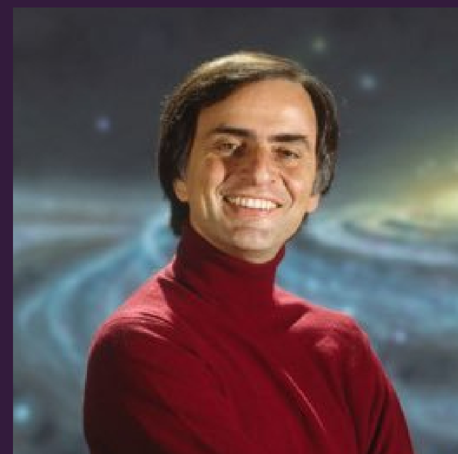
My grandfather points to the full autumn moon, telling tales in foreign tongues about rabbits and runaway goddesses. He tells me of Chang’e, immortality, and the Sun. Mooncake in hand, I ask him of constellations, of the Ursas and their myths. He responds with a shake of the head, with a “*duì bù qǐ, bù zhī dào”*: “I’m sorry, I don’t know."

So I point to the mother bear, squinting against the nearby streetlights. “Her real name is Callisto,” I say in broken Chinese. I gesture towards Ursa Minor, whose real name is Arcas, and tell my grand-father the tale of Callisto and Zeus, half in English, half in Chinese. He smiles, says his sky has a different story. He says the Emperor is the brightest star, and around him are three enclosures for protection. It seems that the bears are guardians of the first enclosure. He calls them the Purple Forbidden Wall.

We sit with our mooncakes and exchange more stories, more tales of the sky, more dreams wished upon fallen meteors. He tells me of Pangu, I tell him of Atlas. He remarks that his countryside heavens were clearer than mine. We share our stories like gifts, precious and unending currencies of time.

SPACE TRIVIA

Which major university denied Carl Sagan tenure in 1968? *(How could they!)*



Carl Sagan
Credit: Tony Korody / Sygma / Corbis

Answer:
Harvard University (their loss)

Trivia selected by Gillis Lowry

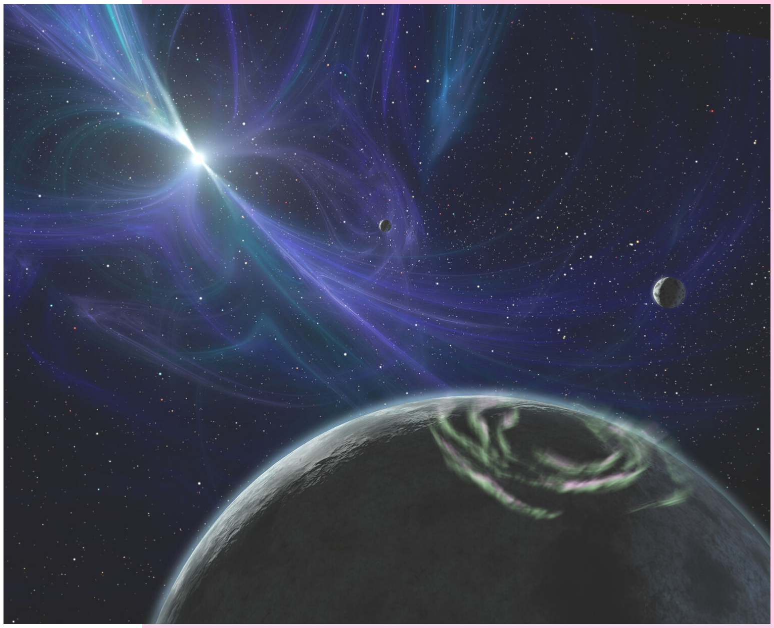
WATER ON EXOPLANETS

BY GILLIS LOWRY

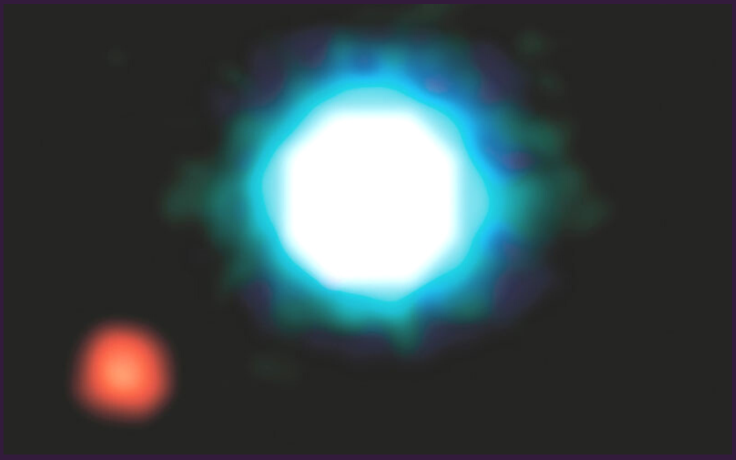
Since the search began in the 1990's, over five thousand exoplanets have been discovered, with eight thousand more waiting to be confirmed. Among these numbers, there may be an entire trove of worlds with life waiting to be found.

To narrow down the search, astronomers tend to limit themselves to a habitable zone around the host star, where temperatures might be suitable for life. Simply being in the habitable zone does not make a planet habitable, however. It still needs the building blocks of life. On Earth, one of the most essential of these is liquid water.

Lisa Kaltenegger, an associate professor at Cornell and Director of the Carl Sagan Institute, authored a study with University of Toronto graduate student Dang Pham testing whether a machine learning algorithm could identify water on exoplanets.



Artist depiction of one of the first exoplanets— due to constant radiation from its pulsar, "Lich", there's certainly no life here
Credit: NASA



The first exoplanet detected via direct imaging (2M1207b), seen as a red dot next to its brown dwarf host star
Credit: ESO

The composition of other worlds is often determined through spectroscopy, or the measurement of chemicals in their atmospheres. This can often be a time-consuming process compared to the method Pham and Kaltenegger tested—"photometry," or "direct imaging," where one records the intensity of light coming from an object.

Certain materials reflect different intensities at different wavelengths, giving them different "signatures" on a graph. Pham and Kaltenegger aimed to determine whether the algorithm XG-Boost, paired with Markov-Chain Monte Carlo, could successfully identify these signatures.

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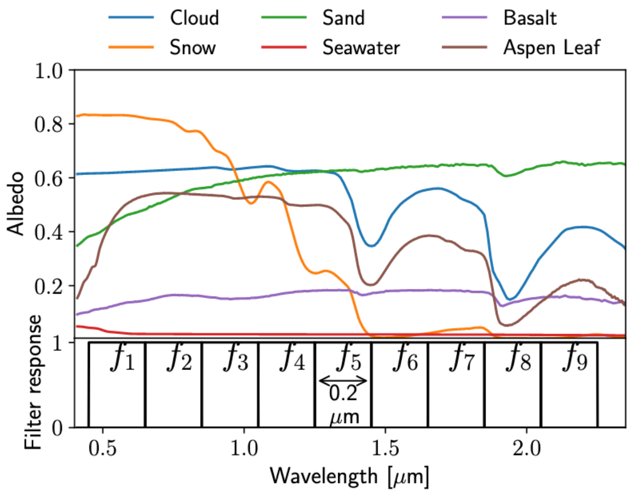
They created a set of over 53,000 imaginary Earth-like planets and gave them differing fractions of Earth-like materials—water, snow, basalt, vegetation, sand, and clouds. The reflectivity of these materials, or their "albedo", is shown on Pham and Kaltenegger's graph on the right. But this is an idealized graph—Pham and Kaltenegger also added some interfering noise to test if the algorithm could still pick out correct signatures from their imaginary planets.

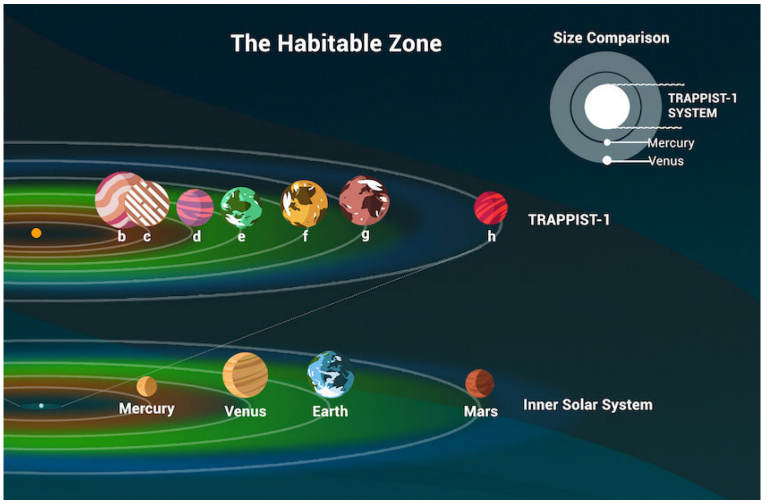


Unique signatures at certain wavelengths; this also helps us determine which broadband (wide wavelength) filters to use when collecting future data
Credit: Pham & Kaltenegger, Clark et al.

The algorithm showed a high balanced accuracy, over 90%, for snow and clouds, and up to 70% for liquid water. The difference in accuracy is due to liquid water having a lower reflectivity, therefore making it harder to identify. Despite this, machine learning algorithms show promise for future identification of exoplanets with water.

"Exoplanets are a relatively new field... The detection of exoplanets shows that our solar system is not unique and there are many other kinds of planetary systems out there," said Pham. "It directly ties to the question of 'are we alone?'"

Upcoming missions hope to answer this—machine learning may soon be applied to data from the James Webb Space Telescope.



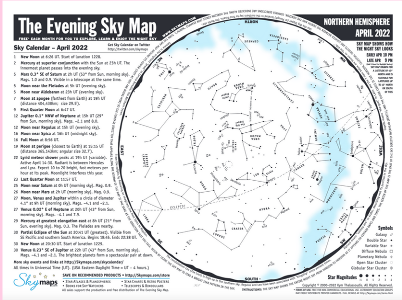
The habitable zone, in green, of TRAPPIST-1 versus our solar system. Planets B and C are likely too hot; H likely too cold
Credit: NASA/JPL-Caltech/Lizbeth B. De La Torre

Dang Pham was a member of CAS from 2016 to 2020. I asked if he might have any advice for current undergraduates at Cornell interested in research. He advises them to contact professors and express interest early. "I find that Cornell professors are quite open to supervising undergraduate research, so just go for it!" he said.

As for any fun memories from CAS, "I definitely miss using Irv on a nice spring Friday night! (Closing the dome when it's -20 outside with windchill is pretty up there on fun, too)."

APRIL SKY MAP

Scan the QR code at right to view this month's evening sky map, courtesy of skymaps.com.



THE ORION NEBULA: WHAT IT IS AND HOW TO FIND IT

BY LUCAS LAWRENCE

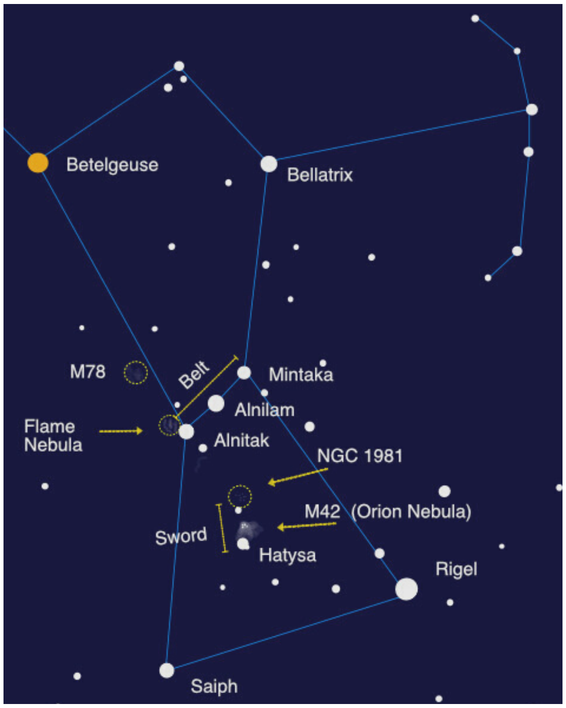
The distant stars in the night sky often seem eternal and unchanging, as though they always were and always will be there. However, while their lives are incomprehensibly long, stars are born, they live, and then they die just as we do (albeit in a more fiery fashion).

Stars are typically born from nebulae of gas and dust, and one of the most famous of these is the Orion Nebula. The Orion Nebula, also known as Messier 42, is one of the most striking non-stellar objects in the sky, appearing as a bright, colorful cloud.

Stars are constantly being born out of this stellar nursery, and our own Sun was likely born in a similar way from a similar molecular cloud. With modern telescopes, we can even see protostars and brown dwarfs at various stages of development, shedding light on how solar systems such as our own came to be.

Despite being located some 1,300 light years away from Earth, the Orion Nebula is visible on clear nights, even when there is considerable light pollution. The Orion Nebula is relatively easy to find thanks to its brightness, so long as you know where to look.

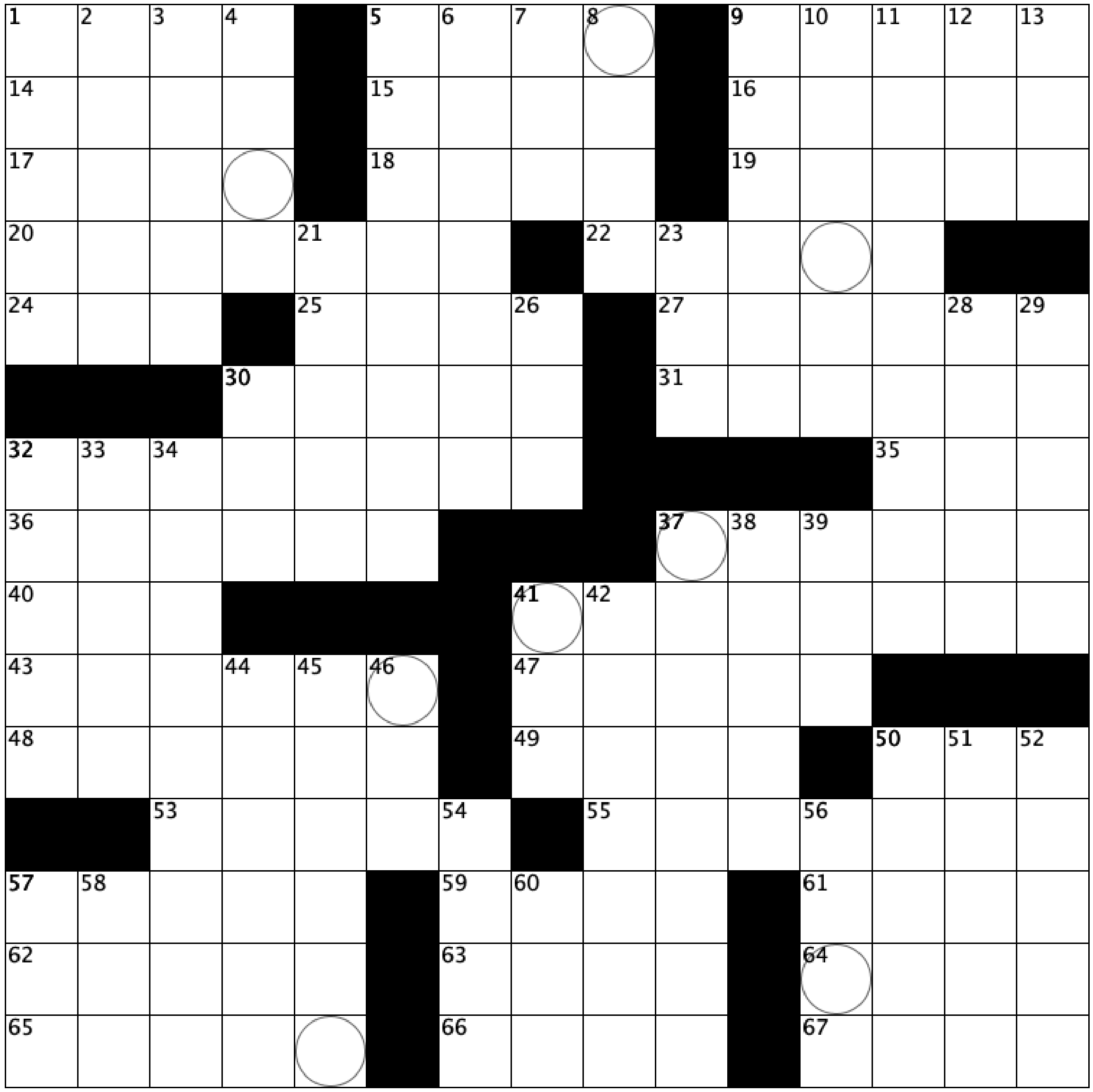
First, find the constellation of Orion, the Hunter, generally in the southern half of the sky as seen from Ithaca. Next, identify Orion's Belt, a line of three bright stars in the middle of the constellation. Finally, look just below the belt at Orion's Sword, within which you will find Messier 42. Orion is a winter constellation, and as we head into summer it will slowly fall beneath the horizon earlier and earlier until it is no longer visible, so make sure to look up at the earliest possible opportunity!



Star chart of Orion and surrounding objects of interest. Credit: [NASA]

Fun Fact: The Orion Nebula is part of a much larger star-forming region called the Orion Molecular Cloud, which is hundreds of lightyears across. This massive region contains dark nebulae, HII regions (regions of hydrogen ionized by bright, newly formed stars), and clouds of gas dispersed by stellar winds and radiation.

BY BEN JACOBSON-BELL



ACROSS

1. Mark of healing
5. Smash Mouth hit
9. Assistants
14. Posh farewell
15. Purchase for a printer
16. Substitute for money
17. Rating accompanying a scathing review
18. Capital of Italia
19. "Laughing" dog-like animal
20. Biblical angel of the abyss
22. LeBron James and Stephen Curry, for two
24. Vietnamese Lunar New Year
25. Entertainment award sweep, for short
27. Barely makes it
30. Laboratory media
31. Cryptozoological subject of the "surgeon's photograph," affectionately
32. Feel drowsy
35. ___ B. Wells, founder of 32-Down
36. "Finally!"
37. Looks up on a clear night, say
40. Bad thing to tear: Abbr.
41. One with straight A's
43. Shirley Temple, for one
47. Cancer treatment, for short
48. ___-mâché
49. Bit of seasoning
50. Unit of texting, for short
53. Fixes, as some dogs
55. Seclude oneself
57. "Three Men in ___" (comedy travelogue)
59. Qualified
61. Central Campus library
62. Language that calls itself Gaeilge
63. Layer of paint
64. Surprise
65. Guiding inspiration
66. Band known for their use of heavy makeup
67. Body art, for short

DOWN

1. Animal also called an ermine
2. Occasionally is
3. Really bothered
4. Child born out of wedlock, medievally
5. High-and-mighty
6. Eleanor, Queen of Castile, in Castile
7. On the ___
8. Bowie character "waiting in the sky"
9. All aquiver
10. Cold looks
11. Consideration for a tailor
12. German article
13. Place for some retreats
21. Impressionist Edgar
23. Me :)
26. Recipe abbr.
28. Noted 2020 electee
29. Rising agent
30. Lovelace often cited as the first computer programmer
32. See 35-Across
33. ___-Sketch
34. Earth's shape (more or less)
37. Kits for newbies
38. Stew often thickened with okra
39. Trouble
41. What pasta water has that regular water doesn't
42. Astrophysicist Rowan, computer scientist Greibach, and others
44. Enzyme that helps break down fats and oils
45. Destroyer of Alderaan
46. Spangled, in a way
50. Island country near Sicily
51. Elevating pole
52. CRISPR targets
54. Something hit when retiring?
56. Cursive or crocheting, e.g., according to some
57. Feel sick
58. Male sib
60. "Sk8er ___" (Avril Lavigne hit)

CREDITS

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Justine Singleton
Lucas Lawrence
Maggie Li
Pedro De Oliveira
Tim Williams

Special thanks

Dang Pham
Annika Deutsch for help with exoplanet research questions
Shawn Hikosaka, Ariel Marxena, and Warrick Ma for providing images

Sources for "Enceladus":

1 -2 - 3 - 4 - 5 - 6 - 7

Enceladus image credit: NASA

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