Ode to Happiness for Sunday May 2 2021

North Star: Polaris and Surrounding Dust

Image Credit & Copyright: Bray Falls

Why is Polaris called the North Star? First, Polaris is the nearest bright star toward the north spin axis of the Earth. Therefore, as the Earth turns, stars appear to revolve around Polaris, but Polaris itself always stays in the same northerly direction -- making it the North Star. Since no bright star is near the south spin axis of the Earth, there is currently no South Star.

Thousands of years ago, Earth's spin axis pointed in a slightly different direction so that Vega was the North Star. Although Polaris is not the brightest star on the sky, it is easily located because it is nearly aligned with two stars in the cup of the Big Dipper.

Polaris is near the center of the eight-degree wide featured image, an image that has been digitally manipulated to suppress surrounding dim stars but accentuate the faint gas and dust of the Integrated Flux Nebula (IFN). The surface of Cepheid Polaris slowly pulsates, causing the star to change its brightness by a few percent over the course of a few days.

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Two Mafia hitmen are walking deep into a forest in the middle of the night.

One of them says, "I gotta admit I'm scared out here."

The other replies, "You're scared? I gotta walk back alone"!

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Anglerfish are stranger than science fiction

In 1833, an almost perfectly spherical fish washed ashore in Greenland and was taken to zoologist Johannes Christopher Hagemann Reinhardt in Copenhagen, Denmark. This fish — later known as the footballfish, *Himantolophus groenlandicus*, or the man-gobbler — was the first anglerfish known to science, wrote Ted Pietsch, a systematist and evolutionary biologist, in his book "Oceanic Anglerfishes" (University of California Press, 2009).

https://www.livescience.com/deep-sea-anglerfish.html?utm_source=Selligent&utm_medium=email&utm_campaign=LVS_newsletter&utm_content=LVS_newsletter+&utm_term=3058026&m_i=fM1JrCABsOVKAx8G5grZuya7L_fcEgdD9LszYJfBbZgI536C55UyQSr6u0Uvxl8gsQ5GucuAa2I9%2B3EvLF6P1vaUirVLsZ7OX6pHLBKffe

Today, there are about 170 known species in 12 families of deep-sea anglerfish, and a "huge diversity" within those families, Mackenzie Gerringer, a professor of biology at SUNY Geneseo in New York who specializes in deep-sea fish told Live Science. Common names for anglerfish hint at some of the wild forms they can take — snaggletooth sea devil, wolf trap and pugnacious dreamer (also known as the tyrannical toad), to name just a few. They sport a fantastic range of shapes and textures; some are squat and round (*Melanocetus johnsonii*), while others are flat and huge-snouted (*Thaumatichthys binghami*) or covered in whiskery filaments (*Caulophryne jordani*). But while these fish are found all over the world, they are fairly elusive, solitary creatures — par for the course for a fish that lives 1,000 to 16,400 feet (300 to 5,000 meters) below the surface. As a result, new species are still being discovered, each more strange than the last.

But no matter what it looks like, any deep-sea anglerfish is a small ocean-dwelling creature's worst nightmare.

https://youtu.be/VqPMP9X-89o

Anglerfish are named for the glowing lure they use to attract the fish and crustaceans they eat. These fearsome hunters lurk quietly in the depths of the ocean. They're ambush predators, Gerringer said, floating and waiting in the dark until prey comes near. Then, they use their built-in fishing rod to lure in the unlucky animal, wiggling, hiding and revealing their lure to tempt potential prey until they are close enough to be sucked up.

This feeding strategy explains anglerfish's bodies: Because they don't actively hunt, they haven't evolved to be fast swimmers, which is why many are blobby, non-hydrodynamic shapes. National Geographic even called anglerfish "quite possibly the ugliest animal on the planet" (though the blobfish would like a word).

Related: This terrifying, toothy 'monster' is the world's deepest-living predator.

In the deep ocean, meals are few and far between. Pietsch wrote in Oceanic Anglerfishes that most anglerfish stomachs that have been examined are empty. So when an anglerfish does come across a meal, they make it last. Anglerfish mouths are often the biggest part of their bodies, and if a meal "can fit in the mouth, it can fit in the body," Gerringer said. Many anglerfish can stretch their stomachs to double their original size.

"They'll end up with a bubble belly," she told Live Science. "Sometimes they're caught and they have whole fish in their stomachs. If you touch the stomachs, it's quite squishy, for lack of a better term."

But don't worry too much about these deep-sea horrors: They're far too small to hurt a human, making their oversized teeth and misshapen bodies… kinda cute? While some anglerfish can grow up to three or four feet (0.9 to 1.2 m) long (like *Ceratias holboelli*), the average size of an adult is 6 inches (16 centimeters) long — a little smaller than a volleyball.

Anglerfish lures glow in the deep ocean, at least half a mile (0.8 kilometers) below the sunlit surface, thanks to luminescent bacteria that take root in the fish's lure. The lure, also called an "esca," has a pore on the end that is designed to host these bacteria, many of which can't live anywhere else, and many of which are unique to that species of anglerfish.

But where do the glowing bacteria come from? Anglerfish are born deep in the ocean as tiny, transparent larvae and float alone to the surface to feed and develop into their adult forms. They don't grow an esca until later in life, so they have nowhere to nurture their bacterial colonies from birth, Gerringer said. "It's a big research question right now," she added. Of the anglerfish esca bacteria that have been studied, none have been found living freely in seawater, Pietsch wrote in his book, meaning that it's unlikely the fish pick their glowing buddies up from their environment. Do they live on an anglerfish's skin until the esca develops? Do they, as one study in the journal eLife suggested in 2019, come from adult anglerfish spewing bacteria into the water, to be immediately picked up by younger fish? "There's a lot of open questions," Gerringer said.

Related: More fish glow than researchers previously expected.

The diverse anglerfish don't stop at a simple glowing lure, though. Some species, such as *Phyllorhinichthys balushkini*, have elaborate light guides protruding from their bodies,

like biological fiber optic cables. Others, like *Cryptopsaras couesii*, have glowing spots on their backs called caruncles. Some, like members of the *Thaumatichthys* genus, have lures on the roofs of their mouths.

Once an anglerfish has lured in its prey, the fish has every incentive to keep it. According to Karly Cohen, a PhD candidate studying the biomechanics of fish teeth at the University of Washington, most animals sport teeth that are firmly attached to their jaws — with anglerfish as a notable exception. Some of their fang-like teeth are "depressable," or able to fold in under pressure. "It could be that the teeth are working similar to a spike guard in a parking garage," Cohen told Live Science. "It's easy for prey to go in the mouth, but hard for them to get out."

To understand anglerfish teeth, Cohen uses a technique called histology. She embeds teeth into resin blocks, and then slices that block microscopically thin. That way, she and her colleagues can stain and identify specific tissues (enamel, pulp and ligaments, for example) to determine how those teeth developed.

But a newer technique allows Cohen to get an even better look at one anglerfish's jawful of fangs. Using a CT scan, Cohen virtually sliced the entire fish into sections that could then be reassembled digitally and viewed from any angle.

Unlike us, Cohen said, "fish put teeth everywhere," and often in places that are hard to spot while just looking at a specimen. With a 3D rendering of a tiny (but ferocious) fish like *Melanocetus johnsonii*, just 2 inches (5 cm) in length, Cohen and her colleagues can make better models of these elusive animals' bite.

Many species of deep-sea anglerfish have one of the weirdest reproduction strategies on the planet. Males are parasites — and we don't mean that metaphorically.

In many deep-sea anglerfish species, the males are often 10 times smaller than females, said Gerringer, and they have no function other than to reproduce. They use highly developed scent organs to track down females. When they find one, they bite into her: According to Cohen, some male anglerfish develop specialized hooked teeth in front of their mouth specifically for getting a grip. (Cohen is researching whether these teeth are true teeth or a kind of proto-tooth called odontodes.) Then, they release an enzyme that dissolves the skin of their mouth, fusing with the female's body. The males become completely dependent on the female for sustenance; their circulatory systems merge so that they're sharing the same blood, and essentially the males become a living pair of testicles.

"Since there's a low probability to run into each other in the ocean, you want to be able to stick together when you find a mate. And they take this to the extreme," Gerringer said.

Females don't stop collecting partners when they have one male fused to them: The record, Gerringer said, is 12 males to one female.

The fusing that takes place is similar to an organ transplantation, since the males essentially become a part of the female's body. Research published in the journal Science in 2020 found out how anglerfish manage this feat: They lack genes to produce

most of the molecules that would attack foreign tissue — plus they have few or no T-cells and antibodies. This lack of an immune system would likely kill a human, study co-author Dr. Thomas Boehm said in a press release describing the study, but it's exactly what anglerfish need to carry out their weird sexual parasitism-based reproduction.

Not many creatures in the ocean eat anglerfish (although some have been found in the stomachs of other deep-sea predators, such as the Antarctic toothfish, *Dissostichus mawsoni*), and since anglerfish make their home in deep water, they are not really targeted or accidentally caught by humans. So you might think that the anglerfish population is perfectly safe.

However, that's not the case. "We think of deep ocean communities as being out of sight, out of mind, but they're closely connected to the rest of the ocean ecosystem," Gerringer said. A recent opinion article published in the journal Proceedings of the National Academy of Sciences argued that deep-sea mining in search of increasingly scarce rare earth minerals could become a threat to the ocean. The emerging technology, as reported by Nature, could shoot sediments and mining waste from the seafloor up into the water column where it could remain in the mid-ocean. That habitat is home not just to anglerfish but tens of thousands of other species, according to a report in Science Daily. That muck could clog up gills, starve filter-feeders and change the way light — and the allure of an anglerfish's esca — travels in the ocean.

Related: RIP, smooth handfish. You were weird, and now you're extinct.

Climate change is a threat too, Gerringer said, by increasing ocean stratification. This means that water isn't mixing from the surface down into the deep ocean as much as it used to, so less oxygen is making its way down to the depths. Ultimately, though, anglerfish are still so mysterious that for many, "we just don't know" how humans might affect them, Gerringer said — or even what their baselines are.

But technology is improving all the time. In 2014, the Monterey Bay Aquarium Research Institute captured the first ever video of a "black seadevil" anglerfish and then brought it to the surface for a closer look, expecting that the fish wouldn't live long at sea level. But in 2018, National Geographic reported how scientists' ability to safely bring live deepwater fish to the surface is evolving. Someday soon, thanks to developments like these and the continued exploration of the deep ocean, we may know more about these bizarre, mysterious creatures.

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Make Your Toddler One of the Gang

https://www.youtube.com/watch?v=KYcGhssznJk

This is when littering pays big dividends.

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Groaners for a Sleepy Sunday

1. Dad, are we pyromaniacs? Yes, we arson.
2. What do you call a pig with laryngitis? Disgruntled.
3. Writing my name in cursive is my signature move.
4. Why do bees stay in their hives during winter? Swarm.
5. If you're bad at haggling, you'll end up paying the price.
6. Just so everyone's clear, I'm going to put my glasses on.
7. A commander walks into a bar and orders everyone around.

8. I lost my job as a stage designer. I left without making a scene.

9. Never buy flowers from a monk. Only you can prevent florist friars.

10. How much did the pirate pay to get his ears pierced? A buccaneer.

11. I once worked at a cheap pizza shop to get by. I kneaded the dough.

12. My friends and I have named our band 'Duvet'. It's a cover band.

13. I lost my girlfriend's audiobook. Now I'll never hear the end of it.

14. Why is 'dark' spelled with a k and not c? Because you can't see in the dark.

15. Why is it unwise to share your secrets with a clock? Well, time will tell.

16. When I told my contractor I didn't want carpeted steps, they gave me a blank stare.

17. Bono and The Edge walk into a Dublin bar and the bartender says "Oh no, not U2 again."

18. Prison is just one word to you, but for some people, it's a whole sentence.

19. Scientists got together to study the effects of alcohol on a person's walk, and the result was staggering.

20. I'm trying to organize a hide and seek tournament, but good players are really hard to find.

21. I got over my addiction to chocolate, marshmallows, and nuts. I on't lie, it was a rocky road.

22. What do you say to comfort a friend who's struggling with grammar? There, their, they're.

23. I went to the toy store and asked the assistant where the Schwarznegger dolls are and he replied, "Aisle B, back."

24. What did the surgeon say to the patient who insisted on closing up their own incision? Suture self.

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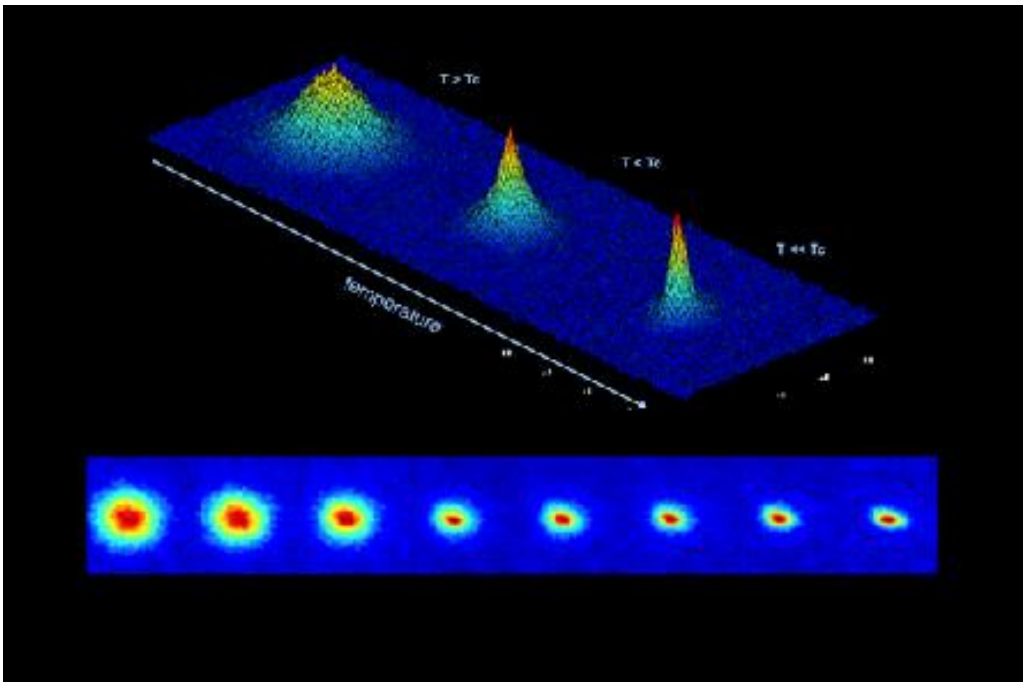
Ultracold Quantum Collisions Have Been Achieved in Space for the First Time



Sequence of false-color images shows the formation of a Bose-Einstein condensate inside a prototype of the Cold Atom Laboratory, a facility now onboard the International Space Station.
Credit: NASA and JPL-Caltech

Creating Bose-Einstein condensates—and crashing them together—in microgravity could lead to physics breakthroughs, better spacecraft navigation and more

By Karmela Padavic-Callaghan for Scientific American

Sequence of false-color images shows the formation of a Bose-Einstein condensate inside a prototype of the Cold Atom Laboratory, a facility now onboard the International Space Station. Credit: NASA and JPL-Caltech

Even for scientists who have dedicated their lives to understanding gravity, the force's relentless downward pull is sometimes a drag. Consider, for instance, the researchers who study Bose-Einstein condensates (BECs) as precise probes of fundamental physics. BECs emerge when a dilute gas of atoms is cooled close to absolute zero and begins behaving as a single, strange chunk of quantum matter—similar to how wriggling water molecules transform into a block of ice once they are chilled. These odd assemblages magnify otherwise hidden quantum-mechanical effects such as the wavelike nature of matter, making them visible at macroscales. Yet sometimes gravity's pernicious influence can get in the way.

Earthbound escapes from gravity's hold involve subjecting BECs to free fall, usually for short spates inside tall drop towers or airplanes flying in parabolic arcs. But the best approach is arguably to leave Earth behind, placing BECs in rockets to experience

longer periods of weightless free fall in outer space. Recently, a team of physicists supported by Germany's space agency reported on doing just that. In Nature Communications this past February, they published the results of a 2017 experiment that manufactured BECs on a millimeter-sized chip in a suborbital sounding rocket almost 300 kilometers above the planet's surface. The BECs then crashed together in the microgravity conditions, allowing the physicists to study the collisions in exquisite detail. Their mission, MAIUS-1, was the first to successfully collide BECs in space, and it points the way toward new space-based tests of fundamental physics.

Clash of the Condensates

When two BECs collide, instead of bouncing off one another like atoms usually do, they interact as waves. When their peaks line up, they form an even taller wave. If the peak of one matter wave overlaps with the trough of another, they cancel each other out, leaving behind empty space. An encounter between two misaligned condensates results in a wave-interference pattern: alternating bright stripes where the two waves enhanced each other and dark stripes where they annihilated each other. Creating and studying these patterns in matter is called atom interferometry.

Onboard the MAIUS-1 rocket, a carefully choreographed system of lasers split the ultracold atoms into multiple matter waves before letting them collide. Images captured inside the rocket, and analyzed once the spacecraft returned to Earth, showed a detailed striped interference pattern that emerged from slight differences in the shapes and positions of each BEC's peaks and troughs. By studying such details, the researchers could tell whether, prior to crashing, the matter waves had been changed by interacting with light or any other forces in their surroundings.

"Atoms are sensitive to all of it," says Naceur Gaaloul, a physicist at Leibniz University Hannover in Germany and co-author on the study. The stripe pattern produced by colliding BECs, Gaaloul says, is a bit like an archeological dig: it helps scientists determine the precise precrash history of the matter waves and pinpoint anything that could have moved their peaks and troughs.

Gravity's pull complicates all of this because it makes BECs fall while they move toward each other, resulting in vanishingly brief clashes and blurred interference patterns. The microgravity conditions of space remove these limitations.

According to Maike D. Lachmann, a physicist at Leibniz University Hannover and the study's lead author, escaping gravity has always been her team's motivation. "The whole thing started in a collaboration, which was aiming to do experiments in a drop-tower facility," she recalls. "But the long-term goal was always going to space."

Dropping ultracold atoms from a nearly 150-meter-high tower bought scientists several seconds of microgravity. The MAIUS-1 rocket bumped that up to nearly six minutes.

"Microgravity is just really where you want to be," says Cass Sackett, a physicist at the University of Virginia, who was not involved with the study. "I expect that as time goes on, we will see atom interferometers in space that are better than anything that's been on the ground." In fact, in 2018 NASA launched an ultracold atom experiment into space. The space agency's Cold Atom Laboratory (CAL) has been cooling atoms onboard the International Space Station (ISS) ever since.

CAL's ability to create quantum states in microgravity for scientists to play with captivated many physicists, including Sackett. Anita Sengupta, an aerospace engineer who served as CAL's project manager during the first five years of its development and was not part of the new study, echoes this sentiment. "My personal motivation behind the mission was to engineer a facility to explore the fundamental physics of the BEC, to open a new doorway into the quantum world," she says. Researchers using CAL have recently performed atom interferometry experiments similar to the work of the MAIUS-1 team as well, Sengupta adds.

Cool Apps for Cold Atoms

Regardless of the specific space-based platform being used, one common research goal for atom interferometry is to test the fundamental principle that bodies of all compositions fall at the same rate under the influence of gravity. According to Lachmann, conducting the MAIUS-1 matter wave interference experiment multiple times using batches of elementally different atoms would test this idea to unprecedented levels of precision. In the unlikely event gravity moved one set of atoms more than the other, their two stripe patterns would be visibly different.

The extreme precision offered by atom interferometry also ushers in the small possibility that signatures of exotic forces, perhaps those associated with some models of dark energy, could be spotted through the technique.

A more immediate and practical application for devices such as the MAIUS-1 chip could emerge in celestial navigation. Because BEC interference patterns are so sensitive to even the smallest fluctuations in gravity, they can be used to map out details of gravitational fields. Similar to how maps of underwater currents help ships navigate, these gravitational-field maps could be useful for fine-tuning a spacecraft's deep-space maneuvers.

During its mission, the MAIUS-1 team already achieved several technological advances. The scientists' experiment fit on a single ruggedized chip rather than being laid out on a large table like the arrangement in most terrestrial laboratories—because it had to survive the rocket's bumpy flight through Earth's atmosphere. Also, the researchers could not communicate with the rocket after it launched, so autonomous systems cooled, manipulated and imaged the atoms. In the future, they want to equip the rocket with commonly used navigation sensors and compare those sensors' performance to that of their chip.

For now, NASA and MAIUS-1 scientists are collaborating on developing upgrades for future installation on CAL onboard the ISS that will offer more options for microgravity experiments, including using atoms that have magnetic spins or that interact with one another strongly. Combining their experiences of trying to wrestle atoms away from gravity's pull, researchers hope to put fundamental physics under an even more powerful magnifying glass in outer space.

Karmela Padavic-Callaghan is a science writer and educator based in Brooklyn, NY.

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Don't Leave Home without Your Camera

You never know what you might miss.

file:///C:/Users/jtrot/Downloads/Take%20your%20camera%20with%20you%20always.pdf

Today's smart phones may not turn you into Edward Weston, but sometimes timing trumps expertise.

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Corvette Clocked at 243 Km/Hour on Coquihalla

BC RCMP Traffic Services was kept busy on Saturday, April 17 conducting speed enforcement on Highway 5, approximately 35 kilometres of Merritt. [BC]

An officer with Traffic Services was shocked when his in-car radar unit captured a northbound Corvette travelling at more than double the 120 km/hr speed limit, registering with an unbelievable speed of 243 km/hr.

“The officer activated his emergency equipment and brought the speeding car to a stop, aborting the driver's ‘flight plan’,” reads a statement from the BC RCMP Traffic Services Media Relations Officer Mike Halskov.

“The driver was issued an Appearance Notice for excessive speed, meaning that the driver must appear in Court, where, upon conviction, penalties may be significantly higher than the maximum fine allowed by serving a ticket. In addition, the vehicle was impounded and the officer is considering other options, including submitting a High Risk Driver report to RoadSafetyBC requesting a lengthy driving prohibition.”

According to provincial statistics, 115 people on average die every year in BC in crashes involving high-risk driving, such as excessive speed.

“Injuries and death that result from high-risk driving behaviours can be prevented, and it all starts with the person behind the wheel,” said Halskov.

“Driving is a privilege and BC is a leader when it comes to holding drivers accountable for their actions. Police remind motorists to obey speed limits, wear seatbelts, drive sober and distraction-free every time you get behind the wheel.”

[For those of us in the US, that’s 145 mph, barely moving for a car that’s good for 184 mph when the factory chip says “stop this.”.]

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Guns N' Roses - Welcome To The Jungle

https://youtu.be/o1tj2zJ2Wvg

"Welcome to the Jungle" was featured on Guns ‘N Roses debut album, *Appetite for Destruction (1987)*. It was released as the album's second single initially in the UK in September 1987 then again in October 1988 this time including the US, where it reached number seven on the Billboard Hot 100 and number 24 on the UK Singles Chart.

Once again I was sequestered in the loving arms of the Marine Corps, so I missed this one.

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Aleksandr Porfiryevich Borodin, (1833-1887), St. Petersburg)

Borodin was a major Russian nationalist composer of the 19th century, as well as a scientist notable for his research on aldehydes.

thefamouspeople.com

Borodin's father was a Georgian prince and his mother an army doctor's wife, and he was reared in comfortable circumstances. His gift for languages and music was evident early on, and as a schoolboy he learned to play the piano, flute, and cello and to compose music.

From 1850 to 1856 he studied at the Medico-Surgical Academy, specializing in chemistry, and received a doctorate in 1858. From 1859 to 1862 he studied in western Europe. On his return to Russia he became adjunct professor of chemistry at the Medico-Surgical Academy and full professor in 1864.

His first major work, the Symphony No. 1 in E-flat Major (1862–67), written as a result of his acquaintance with Mily Balakirev, of whose circle (The Five) he was a member, along with Nikolay Rimsky-Korsakov, Modest Mussorgsky, and César Cui.

Borodin began his Symphony No. 2 in B Minor in 1869, when he also began work on his operatic masterpiece, Prince Igor (completed posthumously by Rimsky-Korsakov and Aleksandr Glazunov). Act II of Prince Igor contains the often-played "Polovtsian Dances." He also found time to write two string quartets, a dozen remarkable songs, the unfinished Symphony No. 3 in A Minor, and his tone poem In the Steppes of Central Asia.

Borodin's musical work was never more than relaxation from his scientific work. In addition to his research and teaching, he helped found medical courses for women in 1872. In the 1880s pressures of work and ill health left him little time for composition. He died suddenly while at a ball.

Borodin's compositions place him in the front rank of Russian composers. He had a strong lyric vein but also was noted for his handling of heroic subjects. He had an unusually fine rhythmic sense and excelled in the use of orchestral colour and in the evocation of distant places. In his symphonies and string quartets—among the finest of the Romantic era—he developed a formal structure in which the musical material of a movement was derived from a single initial motif. His melodies reflect the character of Russian folk melodies, and like other composers of the Russian national school he used striking harmonies unconventional in western European music.

youtube.com

Youtube.comIn the Steppes of Central Asia, Polovtsian dances (Svetlanov)
https://www.youtube.com/watch?v=_WJWmZzVi_c

String Quartet No. 2
https://www.youtube.com/watch?v=_WJWmZzVi_c

Petit Suite
https://www.youtube.com/watch?v=utEzRXtjFiw

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Poetry for a Warm Spring Day

Jehovah's Beard

Pruning ruffling green strands today,
the beard returned
a momentary experience
perhaps a year ago
beard belonging to man
who sharpens knives
big as a butcher
sitting on chair
under umbrella
along road by someone's
fruit stand.

I park and pruning shears in hand
approach
closer I get
another realm enters
fixated on his beard
as alive as the Niagara river
or cluster of comets streaming together
I am taken
the power of the beard
Biblical proportions
yet neat
tended to like
a prized possession.

inches thick and black
oh so wavy
black with wavy white hairs
riding the
pulsing Niagara
dancing comets

man sits still
open to my approach.

I am so close now
bending over
as if peering
I was peering
and at the same time
quickly becoming lost
in the thick swirl
of the power of that
black and white
wrapping around
all of me
and more of me
than I know
all of me
and more of me
somehow I managed to raise
my eyes
reluctantly
raise my eyes into his
and ask
do you sharpen pruning shears, too?

Yes
leaving them I returned in an hour
we never spoke of my approach
the abandonment of me as I know myself
did he sense?
Would he care?
Sitting still on his chair
his beard
a frenzy of other spheres
its own winking way
welcomed me in.

Katherine Holden

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CDC Now Recommends
Wearing A Seat Belt Even
When You're Outside The Car

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Game Changers

First Aerial Color Image of Mars by the Ingenuity Helicopter

First color image of the Martian surface taken by an aerial vehicle while it was aloft.
Credit: NASA/JPL-Caltech

This is the first color image of the Martian surface taken by an aerial vehicle while it was aloft. The Ingenuity Mars Helicopter captured it with its color camera during its second successful flight test on April 22, 2021. At the time this image, Ingenuity was 17

feet (5.2 meters) above the surface and pitching (moving the camera's field of view upward) so the helicopter could begin its 7-foot (2-meter) translation to the west – away from the rover. The image, as well as the inset showing a closeup of a portion of the tracks the Perseverance Mars rover and Mars surface features, demonstrates the utility of scouting Martian terrain from an aerial perspective.

The winding parallel discolorations in the surface reveal the tread of the six-wheeled rover. Perseverance itself is located top center, just out frame. "Wright Brothers Field" is in the vicinity of the helicopter's shadow, bottom center, with the actual point of takeoff of the helicopter just below the image. A portion of the landing pads on two of the helicopter's four landing legs can be seen in on the left and right sides of the image, and a small portion of the horizon can be seen at the upper right and left corners.

Mounted in the helicopter's fuselage and pointed approximately 22 degrees below the horizon, Ingenuity's high-resolution color camera contains a 4208-by-3120-pixel sensor.

The Ingenuity Mars Helicopter was built by JPL, which also manages this technology demonstration project for NASA Headquarters. It is supported by NASA's Science Mission Directorate, Aeronautics Research Mission Directorate, and Space Technology Mission Directorate. NASA's Ames Research Center and Langley Research Center provided significant flight performance analysis and technical assistance during Ingenuity's development. AeroVironment Inc., Qualcomm, Snapdragon, and SolAero also provided design assistance and major vehicle components. The Mars Helicopter Delivery System was designed and manufactured by Lockheed Space Systems, Denver.

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