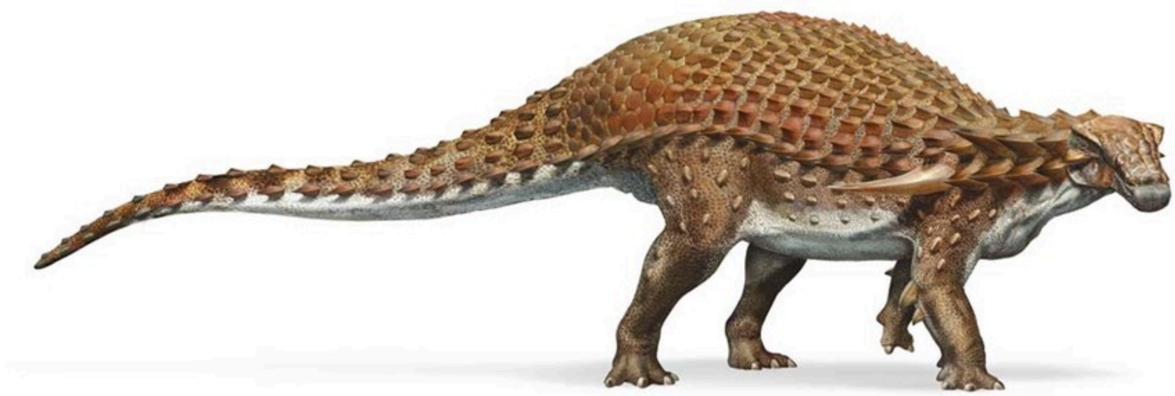
FROM THE JANUARY/FEBRUARY 2018 ISSUE of Discover magazine

#27 How to Preserve a Dinosaur

Remains of 112 million-year-old plant-eater show off impressive body armor and shoulder spikes.

By Sylvia Morrow



The fossils of *Borealopelta markmitchelli* helped provide a detailed guide to illustrating what the armored dinosaur looked like 112 million years ago.

Royal Tyrrell Museum technician Mark Mitchell estimates he spent 7,000 hours chipping away at rock to uncover this 112 million-year-old dinosaur fossil, put on display at the Alberta museum in May. Described formally in August in *Current Biology*, the animal's name, *Borealopelta markmitchelli*, is a nod to Mitchell's dedication.

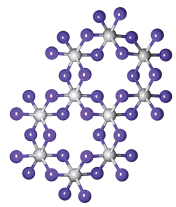
The plant-eating, tanklike nodosaur is unusually well preserved, including its hefty body armor, large shoulder spikes and even pieces of soft tissue. Only the animal's front half was found; its partly exposed innards include the fossilized remnants of a last leafy meal. Don Henderson, the Royal Tyrrell's curator of dinosaurs, believes that soon after death, the nodosaur's bloated carcass floated down a river out to the ancient Albertan sea where "eventually the body went pop, and he sank like a stone." Sediment must have then rapidly buried the body, preserving it with lifelike detail.

FROM THE JANUARY/FEBRUARY 2018 ISSUE of *Discover*

#34 One Magnet to Bind Them All

Monolayer magnet could improve computer memory.

By Sylvia Morrow|Thursday, February 01, 2018



A single layer of chromium triiodide (chromium atoms in gray, iodine in purple)

A frenzy for two-dimensional materials kicked off in 2004 with the creation of graphene — made from just a single layer, or monolayer, of carbon atoms. Researchers have since made monolayers of metals, semimetals, insulators and more, but magnetism was the final holdout. In June, Xiaodong Xu of the University of Washington published results of the first isolated monolayer magnet in *Nature*.

The new magnet, made of chromium triiodide (CrI3), has some curious properties, just like previous 2-D materials. A single layer of CrI3 crystals was magnetic, but two layers were not. Yet when a third layer was added, the magnetism reappeared. Future applications could use this quirk to switch between magnetic states in computers — difficult using current technology — to improve computer memory.

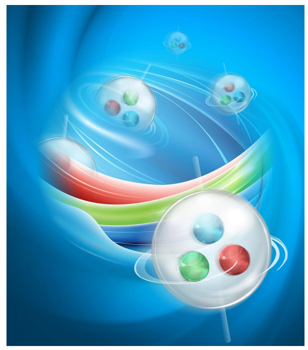
It's unlikely CrI3 itself will end up in commercial devices. It reacts strongly with water and oxygen, evaporating within seconds of being exposed to air. But Xu has high hopes the discovery will lead to new fundamental physics. "What we're really looking for is anything beyond what we can imagine," he says. "I'm sure it's there."

FROM THE JANUARY/FEBRUARY 2018 ISSUE of Discover magazine

#38	The Fastest Fluid

Superhot material spins at an incredible rate.

By Sylvia Morrow



Protons and neutrons are familiar as tiny solids, but particle accelerators can melt them into what's called a quark-gluon plasma, or QGP. Studies of the superhot material, first done about a decade ago, have revealed QGP is the hottest, least viscous known liquid and is capable of forming the smallest drop of liquid ever seen. And now, it's also the fastest known spinning liquid, as reported in August by the STAR collaboration in *Nature*.

In a single second, the authors (an international collaboration working with Brookhaven National Laboratory's STAR detector) saw the QGP goop rotate a mind-boggling sextillion times — a billion trillions. Getting even small pieces of new information from these experiments is always a challenge, so an experimental measurement of an entirely new feature like rotation speed is huge.

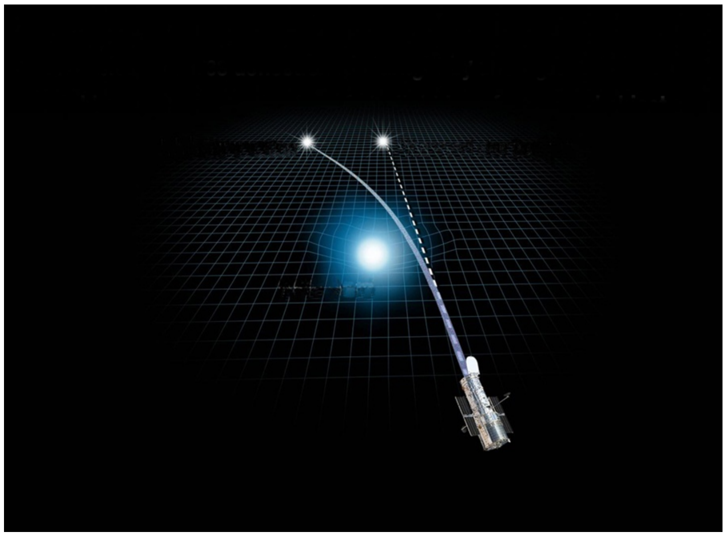
QGP production is sometimes referred to as "tiny big bangs" because shortly after the Big Bang, the universe consisted of QGP. These experiments help us understand the fundamental properties of our universe and its origins, and lead the way toward testing emerging theories.

FROM THE JANUARY/FEBRUARY 2018 ISSUE of Discover magazine

#49 Weighing a White Dwarf

With some help from Einstein, astronomers calculate the mass of a star named Stein 2051 B.

By Sylvia Morrow|Thursday, February 01, 2018



Astronomers used the Hubble Space Telescope to learn a white dwarf's (middle) mass by seeing how much it deflected another star's light. The star's real position the top left, while its observed position is the top right.

NASA, ESA, K.SAHU (STCI)

Three years ago, astronomers put a white dwarf on a scale and watched the needle move. Not literally, says Kailash Sahu, an astronomer at the Space Telescope Science Institute, but their pioneering method of weighing the star really is that straightforward. Their findings appeared in *Science* in June.

When the dwarf, named Stein 2051 B, passed in front of another star from Earth's perspective, Sahu's team followed the position of the background star. As general relativity predicts, light from the background star bent around the white dwarf, distorted by its gravitational field. Like the deflection of a scale's needle, the deflection of the background star's light let astronomers calculate the white dwarf's mass (roughly

67.5 percent the mass of our sun). The movement was minute, but the results were stunning. “I almost fell off my chair,” says Sahu.

The white dwarf’s mass was exactly in line with predictions made in a theory developed by Subrahmanyan Chandrasekhar in 1930. Previous attempts to confirm the theory had relied on shaky assumptions, but Sahu’s group demonstrated Chandrasekhar’s accuracy while proving their own new method really works.

Published in the November 2017 issue of *Discover*

20 Things You Didn't Know About ... Color

The human eye actually sees only three colors, scientists refer to color in terms of wavelength, and coloring foods goes back at least 3,500 years.

By Sylvia Morrow

1. For centuries, academics thought colored light was modified white, or “pure,” light. (We’ll get back to how wrong they were in a bit.)

2. And color sometimes is a modifier. For example, coloring foods goes back at least 3,500 years, when ancient Egyptians added wine and other colorants to candy to increase its visual appeal.

3. The history of coloring food is stained with nefarious deeds. Toxic lead- and mercury-based compounds were once pervasive in Asia and Europe to add color to tea and cayenne and curry powders.

4. In the mid-18th century, Americans were so used to yellow milk, tinted with lead chromate to disguise the bluishness of watered-down dairy, that people refused to purchase white milk, thinking it had been colored.

5. They weren’t entirely wrong. In the 1660s, Isaac Newton demonstrated white light is anything but pure: It’s composed of all colors of light combined.

6. Scientists refer to color in terms of wavelength, a characteristic of electromagnetic radiation, but there is no universal match of specific wavelength values to specific color names. *Encyclopaedia Britannica*, for example, defines blue light as having a wavelength of 450 nanometers, but the average person might call anything between 425 nanometers and 490 nanometers “blue.”

7. And that's just in English. Other languages, including many tribal African tongues, describe green and blue as different shades of the same color.

8. In Russian, light and dark blue are distinct colors, rather than different shades of the same color.

9. Regardless of language, our biology is the same. Human eyes have evolved trichromatic vision: We only see red, green and blue. Full perception happens in the brain. If your eyes see lots of red and green, but not much blue, your brain decides you're seeing yellow.

10. Any color where the amount of red, green and blue appear equal will seem gray to humans.

11. This, of course, assumes color vision. Red-green colorblindness occurs when red or green color receptors are missing or mutated, primarily in people with XY chromosomes.

12. In XX-chromosome individuals, however, the same mutated color receptors may provide what's called four-color vision, though researchers disagree on tetrachromacy's characteristics and prevalence.

13. In 2010, 62 years after the first suggestion of human tetrachromacy, a study identified a woman with distinctly enhanced vision. She was picked for the test because two of her three sons had reduced sensitivity to green, suggesting she had the mutation.

14. No matter how many we can see, all colors result from interaction between light and electrons. Figuring out what type of interaction is responsible for each color can be a challenge, however, since there are 15 different mechanisms.

15. Cobalt pigment, for example, makes the rare gemstone blue spinel a deeply saturated blue, while the Maxixe-type beryl gem may appear dark blue after exposure to radiation.

16. And wings of the Morpho butterfly appear as different shades of blue or even violet depending on how the light hits them. This effect is typical with light-scattering structures like the tiny scales that cover the insect's wings.

17. In 2015, researchers found that the wings of the dragonfly *Zenithoptera lanei*, though similar in appearance to Morpho wings, get their color from waxy crystals that cover layers of the pigment melanin.

18. This effect, called structural color, has also been found in chameleons that can "tune" nanocrystals in their skin to change color the way tuning a guitar changes its pitch, as reported in 2015 in *Nature Communications*. The lizards tune up for camouflage as well as mating displays and possibly thermal regulation.

19. Color can also change during chemical reactions. When the hemoglobin in red blood cells loses oxygen, it takes on a bluish tint. But "blue blood" is a myth: Blood flowing through our bodies is dark red due to a mix of hemoglobin with different levels of oxygen.

20. Dark green blood *can* be a thing, however. In a non-fatal 2005 case, a Canadian man's blood turned green after he took too much migraine medication. Sulfur atoms had started to bind with his hemoglobin, a process that would typically only occur in putrefying corpses. (Sorry to wrap things up on a dead note. Hope I didn't give you the blues.)