BACKYARD ASTRONOMY

Night sky in winter

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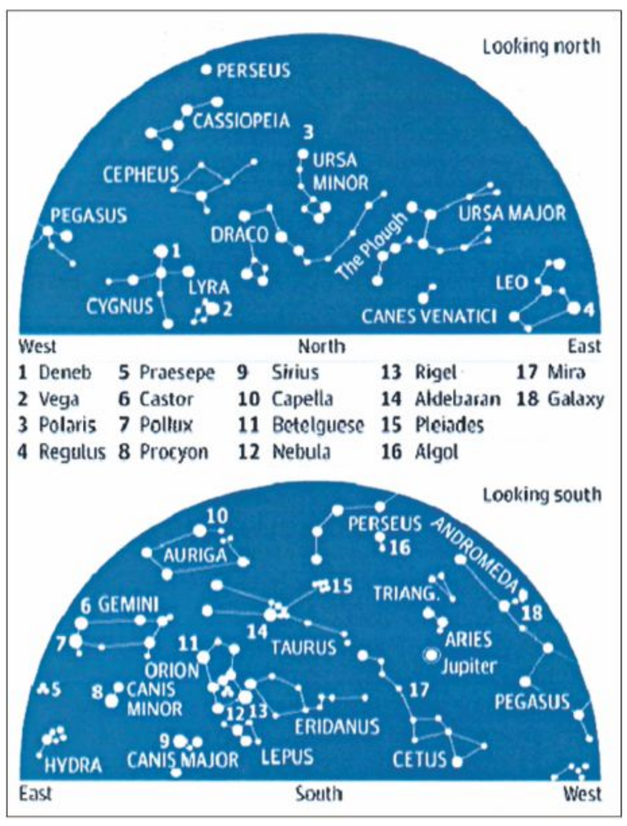
AGAINST the ebony darkness of space, the night sky in winter blazes with dazzling display of heavenly objects - bright stars, constellations, supergiants, stellar nursery - that cannot be seen at other times of the year. Out of the few thousands of stars visible with naked eye, the ones that will stand out are in the constellations Orion the Hunter, Taurus the Bull, and Auriga the Charioteer. Two of the signposts that you can use to navigate the "diamond-studded" night sky are Orion and Big Dipper in the constellation Ursa Major. While Ursa Major and its sister Ursa Minor are on one side of the sky, two lesser known star groups, Canis Major and Canis Minor, the Big and Little Dogs, respectively, can be found on the other side.

Big Dipper will be climbing the northeastern sky, with the three stars of its handle pointing toward the horizon and the four stars of its bowl standing highest. As always, Polaris (North Pole Star) can be found by extending a line from the upper most stars in the bowl across the bowl to the left of the Dipper. The altitude of Polaris above the horizon equals your latitude north of the equator.

Draco the Dragon, a long, sprawling circumpolar constellation with really no bright star, can be seen wrapped around Ursa Minor. It never sinks below the horizon, but moves in a circular path around Polaris. In Draco you will find the star Thuban which used to be the North Pole Star at the time when Pyramids were being built. In the early evening if you look higher above the horizon from Polaris you will see Cassiopeia, the Queen of Ethiopia, whose five main stars make up a W or M pattern. Next to Cassiopeia is Cepheus, her husband and father of Andromeda. Cepheus is notable for the presence of the variable star Delta Cephei, a faint star whose brightness



doubles every 5.4 days. By late January, Leo the Lion will come into view in the northwestern sky, right below Ursa Major.

Central to the brilliant scene in the heavens will be Orion. It heralds the onset of winter and can be located by turning around with your back to the Dipper. During the first few weeks in December, this "heavenly cosmic giant," the most dominating constellation in the sky, emerges above the eastern horizon early in the evening.

The unmistakable belt of Orion is three closely spaced stars that form a straight line. Draw an imaginary line joining the stars in the belt to the upper right. It will lead to Taurus and its orange-colored star Aldebran. Reverse the direction of your gaze to the belt's lower left and you cannot miss Sirius the Dog Star - brightest in the heavens. The close proximity of Sirius, 8.8 light years from our solar system and energy output about twenty-five times that of our Sun, combines to make it the brightest star in the sky.

If you want to stimulate the heart of your beloved, go out together on Valentine's Day and watch a bright red star on the left shoulder of Orion. It is the Hunter's Valentine star supergiant Betelgeuse, the niftiest object in the sky. On the other shoulder is a less bright red star called Bellatrix. Above and to the left of Orion, you will see a pair of bright stars, Castor and Pollux, the twins in Gemini. Now look south of the belt instead; your gaze will fall on the blue supergiant star Rigel, Orion's other luminary.

On winter evenings the brilliantly shining star Capella in the constellation Auriga will be nearly overhead of Orion. If you draw an imaginary line through Orion's belt and extend it southward, you will see Procyon in Canis Minor the Little Dog. The stars Procyon, Sirius, Castor, and Pollux form the retinue of the Great Winter Arc glimmering prominently in the southeastern evening sky.

Finally, aim your binoculars at the line of stars below the belt of Orion where you will notice a fuzzy star. It is a stellar nursery in the resplendent Orion nebula containing bright and newly formed stars. To the British novelist Llewelyn Powys, "No sight that human eyes can look upon is more provocative of awe than is the night sky scattered thick with stars."

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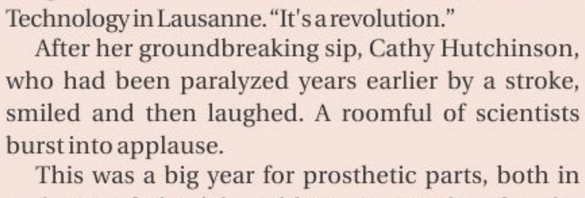
CHIP-IN-HEAD

Bionic man a reality



With the help of an implanted brain chip, a paralyzed woman used her thoughts to direct a robotic arm to pick up a cup of coffee and bring it to her lips to drink.

OUTFITTED with a bionic eye, arm, legs and fantastic '70s hair, Steve Austin was a cyborg whose implants allowed him to recover stolen atomic weapons, fight aliens and protect cryptographers in distress. Finally, real life is starting to catch up with the Six Million Dollar Man. In one of this year's bionic breakthroughs, a paralyzed woman carried out her own superhuman feat: Using an implanted brain chip, she controlled a robotic arm with her mind (SN: 6/16/12, p. 5). She used the arm to grasp a cuppa joe and take a long, satisfying sip of coffee through a straw, an act she hadn't done on her own for nearly 15 years.

"We're entering a really exciting area where we can develop all sorts of very complicated technologies that can actually have biomedical applications and improve the quality of life for people," says bioengineer Grégoire Courtine of the Swiss Federal Institute of Technology in Lausanne. "It's a revolution."

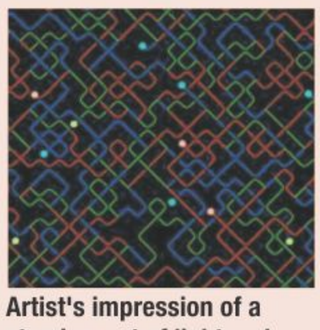
After her groundbreaking sip, Cathy Hutchinson, who had been paralyzed years earlier by a stroke, smiled and then laughed. A roomful of scientists burst into applause.

This was a big year for prosthetic parts, both in and out of the lab. Athletes in London for the Paralympics and the Olympics sprinted on high-tech carbon blades and hurled javelins while balancing on the microprocessor-controlled C-Leg. People in wheelchairs used battery-powered robotic suits to keep their lower limbs in shape. A young man who lost his right leg in a motorcycle accident climbed the 103 flights of stairs in Chicago's Willis Tower with a thought-controlled limb.

Source: **Science News**

SYMMETRY-PROTECTED

500 phases of matter?



Artist's impression of a stssring-net of light and electrons.

CONDENSED matter physics -- the branch of physics responsible for discovering and describing most of these phases -- has traditionally classified phases by the way their fundamental building blocks -- usually atoms -- are arranged. The key is something called symmetry.

To understand symmetry, imagine flying through liquid water in an impossibly tiny ship: the atoms would swirl randomly around you and every direction -- whether up, down, or sideways -- would be the same. The technical term for this is "symmetry" -- and liquids are highly symmetric. Crystal ice, another phase of water, is less symmetric. If you flew through ice in the same way, you would see the straight rows of crystalline structures passing as regularly as the girders of an unfinished skyscraper. Certain angles would give you different views. Certain paths would be blocked, others wide open. Ice has many symmetries -- every "floor" and every "room" would look the same, for instance -- but physicists would say that the high symmetry of liquid water is broken.

Classifying the phases of matter by describing their symmetries and where and how those symmetries break is known as the Landau paradigm. More than simply a way of arranging the phases of matter into a chart, Landau's theory is a powerful tool which both guides scientists in discovering new phases of matter and helps them grapple with the behaviours of the known phases. Physicists were so pleased with Landau's theory that for a long time they believed that all phases of matter could be described by symmetries. That's why it was such an eye-opening experience when they discovered a handful of phases that Landau couldn't describe.

Source: **Science Daily**

Super-fine sound beam as scalpel

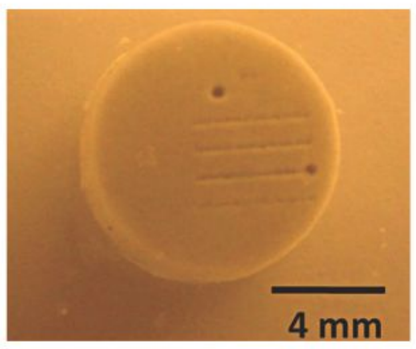
A carbon-nanotube-coated lens that converts light to sound can focus high-pressure sound waves to finer points than ever before. The University of Michigan engineering researchers who developed the new therapeutic ultrasound approach say it could lead to an invisible knife for noninvasive surgery.

Today's ultrasound technology enables far more than glimpses into the womb. Doctors routinely use focused sound waves to blast apart kidney stones and prostate tumors, for example. The tools work primarily by focusing sound waves tightly enough to generate heat, says Jay Guo, a professor of electrical engineering and computer science, mechanical engineering, and macromolecular science and engineering. Guo is a co-author of a paper on the new technique published in the current issue of Nature's journal Scientific Reports.

The beams that today's technology produces can be unwieldy, says Hyoung Won Baac, a research fellow at Harvard Medical School who worked on this project as a doctoral student in Guo's lab.

"A major drawback of current strongly focused ultrasound technology is a bulky focal spot, which is on the order of several millimeters," Baac said. "A few centimeters is typical. Therefore, it can be difficult to treat tissue objects in a high-precision manner, for targeting delicate vasculature, thin tissue layer and cellular texture. We can enhance the focal accuracy 100-fold."

The team was able to concentrate



Focused sound waves for micro-surgery. Researchers drilled a 150-micrometer hole in an artificial kidney stone.

high-amplitude sound waves to a speck just 75 by 400 micrometers (a micrometer is one-thousandth of a millimeter). Their beam can blast and cut with pressure, rather than heat. Guo speculates that it might be able to operate painlessly because its beam is so finely focused it could avoid nerve fibers. The device hasn't been tested in animals or humans yet, though.

"We believe this could be used as an invisible knife for noninvasive surgery," Guo said. "Nothing pokes into your body, just the ultrasound beam. And it is so tightly focused, you can disrupt individual cells."

To achieve this superfine beam, Guo's team took an optoacoustic approach that converts light from a pulsed laser to high-amplitude sound waves through a specially designed lens. The general technique has been around since Thomas Edison's time. It has advanced over the centuries, but for medical applications today, the process doesn't normally generate a sound signal strong enough to be useful.

The U-M researchers' system is unique because it performs three functions: it converts the light to sound, focuses it to a tiny spot and amplifies the sound waves. To achieve the amplification, the researchers coated their lens with a layer of carbon nanotubes and a layer of a rubbery material called polydimethylsiloxane. The carbon nanotube layer absorbs the light and generates heat from it. Then the rubbery layer, which expands when exposed to heat, drastically boosts the signal by the rapid thermal expansion.

The resulting sound waves are 10,000 times higher frequency than humans can hear. They work in tissues by creating shockwaves and microbubbles that exert pressure toward the target, which Guo envisions could be tiny cancerous tumors, artery-clogging plaques or single cells to deliver drugs. The technique might also have applications in cosmetic surgery.

In experiments, the researchers demonstrated micro ultrasonic surgery, accurately detaching a single ovarian cancer cell and blasting a hole less than 150 micrometers in an artificial kidney stone in less than a minute.

"This is just the beginning," Guo said. "This work opens a way to probe cells or tissues in much smaller scale."

The researchers will present the work at the SPIE Photonics West meeting in San Francisco. The research was funded by the National Science Foundation and the National Institutes of Health.

Source: **Science Daily**

WOOL OVER EYES

Disposable gecko tail

LIKE a pair of Velcro stripper pants, gecko tails come off easy. The lizards have pre-formed score lines in their tail that allow them to quickly rip off their tails when a predator has grabbed it, according to a new study.

The gecko tails, which were described Wednesday (Dec. 19) in the journal PLoS One, essentially stick to the body of the animals with adhesive forces.

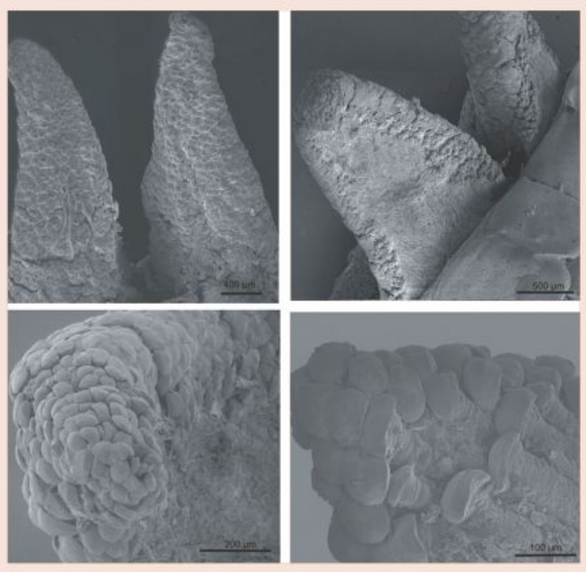
"The tail contains 'score lines' at distinct horizontal fracture planes where the tail may be released as a response to predation," the authors wrote in the article. "These scores penetrate all the way through the tissue where the structural integrity is maintained by adhesion forces."

While scientists have long known that geckos and other amphibians shed their tails to evade predators (and then regenerate them later), exactly how has been steeped in mystery. One possibility was that the lizards had special fast-acting chemicals that essentially broke down connective tissue that held the tail on. But it wasn't clear how chemicals could do that so quickly. [The 10 Weirdest Animal Discoveries of 2012]

To find out how the lizards lose their tails, the team used several types of microscopes to visualize the lizard tail's structure and also observed the appendage shedding in euthanized geckos.

They found the gecko tail had zigzag lines that separated segments of the tail, forming a "precut" line. When the geckos shed their tail, they left behind a pointy, crown-shaped stump. At the stump, the team was able to see bizarre, mushroom-shaped structures. Those structures, the team hypothesizes, form to reduce the adhesive, or sticky, forces and allow the gecko tail to rip off.

Source: **Live Science**



When the gecko sheds its tail, it leaves zig-zagged extensions at the stump.

TIME OF WARMTH

A striking image of Verrazano Bridge in Brooklyn as Hurricane Sandy approaches on Oct. 29, 2012.

SOURCE: LIVE SCIENCE

A memorable year

Drought, wildfire, hurricanes, a deadly typhoon and cold snap this year had a lot to offer in terms of weather news.

Weather historian Christopher C. Burt, who blogs for the meteorological website Weather Underground, has been keeping tabs on events this year, and the headliner is clear, he said: Unusually warm temperatures, most notably across the continental United States.

We take a look back at the most significant weather of 2012:

Record-breaking warmth: The data for the last of the year isn't in yet, but this year looks "virtually certain" take the title of warmest year on record for the lower 48 states, according to the U.S. National Oceanic and Atmospheric Administration (NOAA).

DID YOU KNOW?

What's dendrochronology?

Dendrochronology or tree-ring dating is the scientific method of dating based on the analysis of patterns of tree rings, also known as growth rings. Dendrochronology can date the time at which tree rings were formed, in many types of wood, to the exact calendar year. This has three main areas of application: paleoecology, where it is used to determine certain aspects of past ecologies(most prominently climate);archaeology, where it is used to date old buildings, etc.; and radiocarbon dating, where it is used to calibrate radiocarbon ages.

The growth rings of a tree at Bristol Zoo, England.

In some areas of the world, it is possible to date wood back a few thousand years, or even many thousands. Currently, the maximum for fully anchored chronologies is a little over 11,000 years from present.