

SCIENCE NEWS

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the stem of consciousness
taming antimatter
planet escapes red giant
sulfur snackers

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**spicing up
memory**

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Cover Spices for sale at a southern-India market include yellow curry powders, which typically contain turmeric. A compound in turmeric, curcumin, may be effective against Alzheimer's disease.
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Alliance of Opposites

Electrons and positrons make new molecule

By soaking a silica sponge with antimatter, physicists have made the first matter-antimatter molecules. With further refinement, the technique might be used to briefly condense antimatter into fluid or solid states or even to create the first gamma-ray laser.

About 10 years ago, researchers created atoms of antihydrogen by combining antiprotons and positrons, the antimatter equivalents of protons and electrons. By itself, antihydrogen is as stable as hydrogen, though it's difficult to store in our matter world because of antimatter's propensity to vanish in a flash of gamma rays as soon as it comes into contact with matter.

For more than 50 years, however, physicists have been able to create nucleus-free "atoms" consisting of one electron and one positron. Attracted by their opposite charges, electrons and positrons will orbit each other, as the stars in a binary system do.

Unlike antihydrogen, however this unusual matter-antimatter hybrid, called positronium, is unstable. It enjoys just a brief dance of death as the two particles spiral in toward mutual annihilation.

Still, positronium can live long enough—up to hundreds of nanoseconds—that physicists had speculated that the atoms might be able to pair up into molecules. Coaxing the atoms to do so would require assembling them in tight quarters and slowing them down enough to allow them to intermingle.

To perform this feat, David Cassidy and Allen Mills of the University of California, Riverside began by trapping millions of positrons—produced by a radioactive source—in an electromagnetic field. By applying brief electric pulses, the team expelled short bursts of positrons, directing them toward a thin, porous silica membrane. Inside the pores, some of the positrons scooped up electrons from the silica to form positronium.

The researchers hoped that some of the atoms would bounce around inside the pores

and even temporarily stick to the pores' inner surfaces, where feeble electrostatic forces might slow them down and allow them to bind to each other as molecules.

All the positrons, whether free or bound in atoms or molecules, eventually annihilated, producing gamma rays. But Cassidy and Mills detected a telltale gamma-ray signal that they had expected the annihilation of molecular positronium to produce. For confirmation, they heated the membrane, creating conditions that would prevent the formation of molecules. Sure enough, the signal disappeared, the team reports in the Sept. 13 *Nature*. Mills says that the data show "all the hallmarks" of the appearance of positronium molecules.

Clifford M. Surko of the University of California, San Diego says that the evidence for the formation of positronium is convincing, if indirect. "I did not find any obvious potential flaw in it," he says.

This achievement is only the beginning, Mills says. If the researchers manage to concentrate more positrons into their sponge, more-complex states of matter should appear. In a Bose-Einstein condensate, an exotic gas in which atoms share a quantum state, positrons could be forced to annihilate in sync to produce the first gamma-ray laser, Cassidy says. Even higher densities could lead to the first solid matter-antimatter state. —D. CASTELVECCHI

Survivor

Extrasolar planet escapes stellar attack

From the sizzling outer atmosphere of a sunlike star to the chilly surroundings of a dark, stellar cinder, extrasolar planets keep turning up in the darndest places.

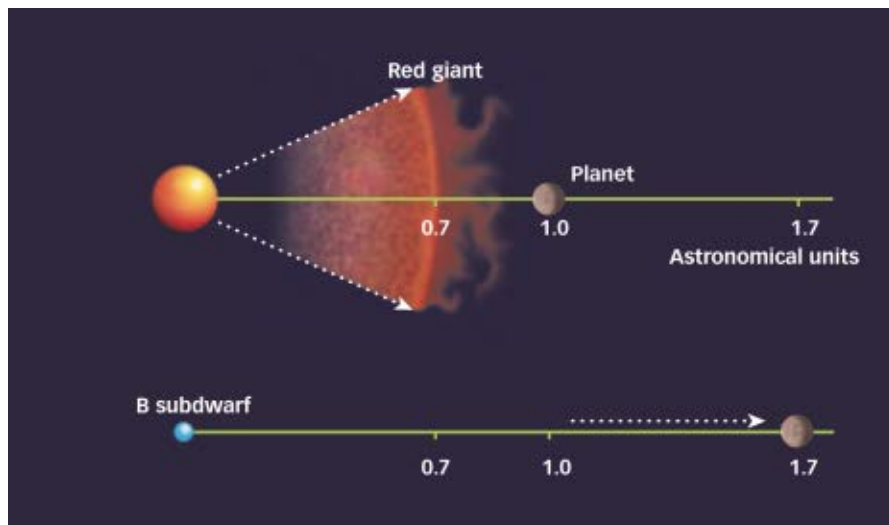
Now astronomers have found a large planet that survived a special type of onslaught. The planet, more than 3 times as heavy as Jupiter, was at one time orbiting the elderly star V391 Pegasi at Earth's distance from the sun. When the aging star ballooned to more than 100 times its former diameter, the giant planet drifted farther away, escaping engulfment. Roberto Silvotti of the INAF-Osservatorio Astronomico di Capodimonte in Naples, Italy, and his colleagues describe this sequence of events in the Sept 13 *Nature*.

Earth will face a similar challenge in about 5 billion years, when our sun swells to become a red giant star. As its outer envelope puffs up, the sun will swallow Mercury and Venus, but Earth's fate is uncertain, theorists say.

Competing forces muddy the picture. The middle-aged sun will shed mass, and its decreasing gravity will let Earth recede. At the same time, its puffy outer layer could envelop Earth, creating a frictional drag that will draw the planet inward.

"[Understanding] what happens to the planet is not at all easy," says Silvotti. "Now at least we know that a giant planet at an [Earthlike] distance can survive" its parent star's red giant phase.

There are some key differences between the sun and V391 Pegasi, which is now a B-type subdwarf. Like other stars of this rare class, it reached its present state by following an unusual evolutionary path, Silvotti notes. The star initially had about the same mass as the sun, and after exhausting the supply of hydrogen at its core it became a bloated red giant. Then, however, it somehow shed its extended envelope, losing half its mass and retaining only a thin skin of atmosphere surrounding its helium core. That mass loss caused its planet to move from an orbit about the size of Earth's to one as big as that of Mars.



ENDURANCE A recently discovered planet has withstood the swelling of its aging parent star, which expanded nearly to 1 astronomical unit, the size of Earth's orbit (top). The star has since shrunk, and the planet has migrated about 70 percent farther from its parent (bottom).

Like the sun, V391 Pegasi will end its life as a still-more-compact, burned-out object called a white dwarf.

It probably would have been harder for V391 Pegasi's planet to survive had it been orbiting a sunlike star, says Jonathan Fortney of NASA's Ames Research Center in Mountain View, Calif. "In the normal transition from red giant to white dwarf, a star undergoes thermal pulses with fairly high luminosity, which could lead to the evaporation of the planet."

Another unusual feature of V391 Pegasi made it relatively easy to detect the planet. The star pulsates. Tiny, periodic changes in the arrival times of the pulses enabled the astronomers to infer that an orbiting, massive planet was pulling the star to and fro.

In 1992, researchers used a similar method to find the first known extrasolar planets. Those planets circle a superdense object called a neutron star, which no one had expected to possess planets.

The discovery of the planet orbiting V391 Pegasi starts to delineate the properties, such as mass and orbit size, that a planet needs to survive the vicissitudes of a star's old age, says Mario Livio of the Space Telescope Science Institute in Baltimore. —R. COWEN

Fish Switch

Salmon make baby trout after species, sex swap

Biologists have implanted male-reproductive tissue from rainbow trout into male and female salmon, which then bred a new generation of baby trout.

In male-salmon recipients, the trout tissue produced sperm, but in female salmon, the same tissue produced eggs, says Goro Yoshizaki of the Tokyo University of Marine Science and Technology. These surrogate parents produced trout that grew up to breed in the usual way, Yoshizaki and his colleagues report in the Sept. 14 *Science*.

Showing that surrogates can create the young of another species implies that "cryo-preserved germ cells from testes of endangered, or even nearly extinct, species should be kept for the future," comments Rune Male, who studies fish reproduction at the University of Bergen in Norway.

Developing techniques for the switch took almost 5 years, Yoshizaki says. The team learned a few tricks from fish farms,

such as dipping fertilized eggs in warm water to create sterile fish. Sterilized masu salmon served as recipients for trout tissue.

The Yoshizaki team showed that newly hatched salmon would not reject implants of foreign tissue. Researchers treated the salmon before they were 46 days old.

The implants came from tissues called spermatogonia, which give rise to germ cells, or sperm, in male trout. The researchers simply injected the trout tissue into the body cavities of the hatchling salmon. "Germ cells have a very special ability to find, and migrate to, gonads," says Yoshizaki.



NOT LIKE FATHER Researchers inserted rainbow trout reproductive tissue into salmon hatchlings (top). When the surgically altered salmon matured, they produced a new generation of trout (bottom), including some showing albino ancestry.

The researchers had earlier discovered that spermatogonia tissue would make eggs when tucked into a female body. That's one of the "important tricks" that makes the surrogacy practical, says Yoshizaki.

After the salmon matured, in 3 years, 10 of the 29 male recipients produced sperm and 5 of the 50 females ovulated. In the best batch of fertilized eggs, 90 percent hatched. Genetic tests confirmed that the young fish came from the tissue-donating trout, the researchers say.

For basic biology, says Male, the demonstration "opens the way for new experiments that may help explain the process of sex determination and differentiation."

Trout are related to salmon and, as the new experiment suggests, share sex-determining mechanisms.

Male notes that salmon and trout eggs can reach 6 millimeters in diameter, too big to preserve well by freezing. The ability to preserve and later use the tissue that generates germ cells could be a boon in efforts to breed fish for both commerce and conservation. Yoshizaki's team has found that 45 percent of cryogenically preserved spermatogonia are alive after thawing.

Yoshizaki says that he's trying to produce bluefin tuna using mackerel as surrogates. Such surrogate parents, a thousandth the size of their offspring as adults, could allow fish farmers to keep tuna-breeding stock in tanks of manageable size. Yoshizaki is also working to create surrogate parents for the endangered Idaho sockeye salmon.

Populations of salmon, trout, and their relatives are declining worldwide, and in the lower 48 states, wild salmon are down to 4 percent of their historic abundance, says Guido Rahr, president of the Wild Salmon Center in Portland, Ore. He points out, though, that high-tech breeding techniques won't help without habitat preservation. "The best fish hatchery in the world is a healthy river system," he says. —S. MILIUS

Debate Renewed

Diabetes drug up heart risk

The popular diabetes drug rosiglitazone, marketed as Avandia, more than doubles the long-term risk of heart failure and increases the long-term risk of heart attack by 42 percent, according to a new analysis.

Rosiglitazone initially came under scrutiny earlier this year when an analysis of short-term trials found a 43 percent increase in risk of heart attack among people taking the drug (*SN*: 6/23/07, p. 397). The Food and Drug Administration called an emergency advisory committee meeting, and in July that group agreed that the drug increases the risk of heart attack. However, the panel recommended that the FDA keep rosiglitazone on the market. The agency is now reviewing data and weighing options on the drug.

To clarify the long-term heart risks of rosiglitazone, Sonal Singh of Wake Forest University School of Medicine in Winston-Salem, N.C., zeroed in on studies lasting a year or longer that specifically tracked the cardiovascular health of participants. Of 140 past human trials of the drug, only 4 met those criteria.

Singh and his colleagues pooled the data

from those four studies, which included 14,291 patients. Of 6,421 patients who took rosiglitazone for at least a year, 94 suffered heart attacks and 102 experienced heart failure, a progressive condition in which the heart struggles to pump blood. In 7,870 patients who took either a placebo or another diabetes medicine, 83 suffered heart attacks and 62 experienced heart failure.

Those figures equate to a 42 percent increase in risk of heart attack and a 109 percent increase in risk of heart failure among patients taking rosiglitazone for at least a year. In absolute terms, 1 in 30 patients taking the drug will develop heart failure and 1 in 220 will have a heart attack because of the drug, according to the researchers.

Philadelphia-based GlaxoSmithKline, the maker of rosiglitazone, estimates that a million people in the United States take the drug.

"The public health impact of potential harm ... is substantial," Singh and his colleagues write in the Sept. 12 *Journal of the American Medical Association*. Singh, an internist, says that he no longer prescribes rosiglitazone. He chastised the FDA for keeping it on the market. "They want absolute proof of harm before they take action," he says. "Who's going to provide that proof?"

Sen. Charles Grassley (R-Iowa), who

advocates tightened FDA oversight, points to the new report as "a case study in what's wrong with the [FDA's] drug-safety system FDA's relationship with drugmakers is too cozy."

GlaxoSmithKline issued a statement saying that the new report "is yet another iteration of previously analyzed data, and offers no new information on the safety of Avandia.... We believe it is inappropriate for the author to advise doctors to disregard the FDA's advice, which is to keep patients who are effectively controlling their diabetes on Avandia." —B. VASTAG

Brain Sabotage

Alzheimer's protein may spawn miniseizures

A sticky protein implicated in Alzheimer's disease disrupts the brain's circuitry by inducing seizures that give barely an outward sign that they're happening, a study of mice shows.

Excessive buildup of a protein called amyloid-beta in the brain is a hallmark of Alzheimer's disease, and scientists have long suspected that this protein plays a deleterious role in the disease.

In the new study, amyloid-beta triggered excessive firing of neurons, leading to subtle seizures in parts of the mouse brain that are central to memory and learning, says study coauthor Lennart Mucke, a neurologist at the Gladstone Institute of Neurological Disease at the University of California, San Francisco. The episodes fall short of causing the jerking motions or convulsions seen in some epileptic seizures, which could explain why their occurrence in mice with an Alzheimer's-like condition had gone largely unnoticed. The findings appear in the Sept. 6 *Neuron*.

Mucke and his colleagues tested mice that were genetically engineered to overproduce amyloid-beta. By age 4 to 7 months, the mice began to show cognitive problems, such as losing their way in a familiar maze. However, the animals' neurons hadn't died, says Mucke. Rather, the mice began to lose function at their synapses, the junctions at which neurons pass messages to one another.

Mucke likens neurons to trees in a forest, with the tip of each branch representing a potential synapse for relaying messages to another neuron. "A tree can lose branches and leaves but still be alive," he says. In the mice, the neurons survived, but the messaging network was damaged after their brains became inundated with the amyloid-beta proteins.

Grazing on the Periodic Table

Some ancient microorganisms lived on a diet of pure sulfur

Analyses of 3.5-billion-year-old rocks from Australia indicate that some of the microorganisms living when those rocks formed were able to derive energy from sulfur, the first time such a metabolic feat has been chronicled in rocks of that age.

Because bacteria have no hard parts, they don't fossilize well. Nevertheless, signs of ancient life are often recorded in a rock's chemistry. For example, bacteria that extract energy by metabolizing sulfate minerals leave behind sulfides partially depleted of the heavier isotopes of sulfur, says Pascal Philippot, a geochemist at the Paris Geophysical Institute.

To discern the influence of such bacteria on ancient rocks, scientists look for a lower-than-normal concentration of the isotope sulfur-34 relative to that of sulfur-32.

In rocks more than 2.7 billion years old, sulfides typically show no sign of sulfur-34 depletion, says Philippot. The absence of that signal in such rocks could mean that sulfate-consuming microbes hadn't yet evolved, he notes.

However, in 2001, a team of scientists reported evidence of sulfate-consumers in 3.5-billion-year-old rocks unearthed at a site in western Australia. Now, additional analyses of rocks from that site by Philippot and his colleagues suggest that the sulfides were indeed created by microbes—but microbes with a highly unusual metabolism.

In the new tests, the researchers also measured the rocks' concentration of sulfur-33, a rare isotope that accounts for less than 1 percent of the element's atoms. If sulfate-consuming bacteria

had created the Australian sulfides, the ratio of sulfur-33 to sulfur-32 in the rocks should have been lower than normal. In some samples, however, the researchers found sulfur-33 concentrations that were as much as 6 parts per thousand above normal. That's a clear sign that the sulfides weren't produced by sulfate consumers, says Philippot.

Instead, the sulfides came from microorganisms that derived their energy by processing pure sulfur, the researchers propose in the Sept. 14 *Science*. The sulfur would have formed in the atmosphere as ultraviolet light broke down sulfur-bearing volcanic gases, a process that would have produced abundant sulfur-33, says Philippot. If bacteria had then consumed such material, the resulting sulfides would have

been enriched in sulfur-33 but depleted in sulfur-34.

Sulfur-consuming bacteria "are the only available explanation for the isotopic trends" seen in the Australian sulfide samples, says Bo Thamdrup, a geochemist at the University of Southern Denmark in Odense. Scientists have isolated only three species of sulfur-consuming bacteria, Thamdrup notes, and their requirements are spartan indeed: The microbes need only sulfur, water, carbon dioxide, and inorganic nutrients to survive.

Despite the simplicity of such microbes, geochemical evidence for their existence has extended back only 1.3 billion years, says Timothy W. Lyons, a geochemist at the University of California, Riverside. "This [finding] is a big step." —S. PERKINS

Previous studies have shown memory and learning deficits in such engineered mice. In the new study, the researchers implanted electrodes in the brains of some of the mice and tracked their brain function using electroencephalogram (EEG) readings as the mice moved freely about their cages. When a mouse was having a mini-seizure, as evident from its EEG readouts, it sometimes froze in its tracks.

Biochemical and anatomical analyses of the brains of these mice revealed high concentrations of neuropeptide Y, a chemical typically released to calm overexcited neurons. In this case, the protective reaction may be overcompensating for the problem of excessive signaling. "In mice with the most severe memory deficits, neuropeptide Y tended to be at maximal levels," Mucke says.

The net effect is dull signaling that depresses the mouse brain's agility, possibly paralleling symptoms in Alzheimer's patients, the scientists conclude.

"This is an important study for sure, suggesting that amyloid-beta isn't just causing neuron death but is also pruning back synapses," says neurobiologist Rudolph Tanzi of Harvard Medical School and Massachusetts General Hospital in Boston. "This adds to a growing body of literature on amyloid-beta deposition. I think this is just the tip of the iceberg. It's a great start toward understanding more about how amyloid-beta deposits disrupt neural circuitry."

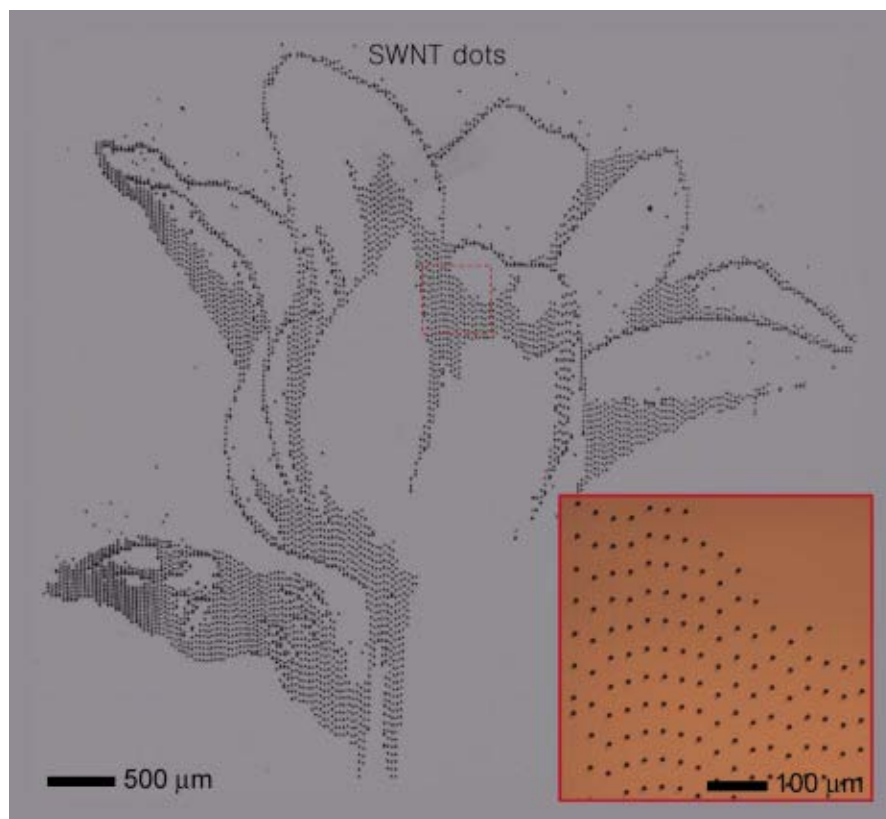
Mucke and his team are designing a trial that would use EEG readings to test for small seizures in people with early-stage Alzheimer's disease. —N. SEPPA

Spot On

Printing flexible electronics one nanodot at a time

Plastic displays, solar cells, and other kinds of gadgets are attractive for their flexibility and potential low cost. But they rely on materials—polymers, nanoparticles, and carbon nanotubes—that are incompatible with manufacturing processes designed for silicon-based devices. Now, researchers have developed a printing process that could make possible mass production of plastic electronic devices.

Many companies are experimenting with ink-jet systems to create flexible printed electronics, usually by adapting standard



FLOWER POWER This printed image of a flower was created with microscopic dots of electronic ink containing carbon nanotubes. Inset shows a magnified detail of the image.

ink-jet printers to dispense fluids with useful electronic properties. But such systems generally can only print features down to 20 microns in diameter—too large for many applications.

John Rogers of the University of Illinois at Urbana-Champaign and his colleagues have devised an alternative strategy called electrohydrodynamic, or e-jet, printing. In contrast to conventional ink-jet printing, which relies on either heat or vibration to push ink droplets out of a nozzle, e-jet printing uses electric fields to pull droplets from the nozzle's tip.

The system consists of a glass nozzle coated with a thin, conducting layer of gold. The coating extends to the tip of the nozzle, where it makes contact with the emerging ink.

The researchers bring the nozzle close to a surface on which they wish to print a pattern, in this case a silicon wafer sitting on a conducting plate. Applying a voltage between the nozzle and the plate produces an intense electric field at the nozzle's tip. As the field draws the ink out of the nozzle, a cone-shaped meniscus forms at the tip and pinches off droplets of fluid.

"Those droplets then travel like bullets down to the substrate," says Rogers. The electric field guides the droplets so that they land directly below the nozzle.

By varying the diameter of the nozzle tip, the Illinois team can control the size of the droplets. The researchers can make nozzles with openings as narrow as 300 nano-

meters, which produce dots just 250 nm across. That's orders of magnitude smaller than drops produced by existing printers, says Rogers. The team describes its research in an upcoming *Nature Materials*.

Paul Calvert, a materials scientist at the University of Massachusetts, Dartmouth, says that the technology is promising. "I'm not aware of anyone else who has achieved this kind of resolution," he adds.

Rogers and his colleagues showed that their e-jet printer works with a wide variety of inks containing conducting or photosensitive polymers, silicon nanoparticles or nanorods, or carbon nanotubes.

To create patterns on a surface, the plate under the silicon wafer is mounted on a computer-controlled mechanical stage. The stage moves the printing surface horizontally while the nozzle remains in place. Rogers' team printed text and various drawings, including a picture of a flower and a portrait of the ancient Greek scholar Hypatia. As a preliminary step toward making functional transistors and other devices, the researchers used the technique to print various patterns of electrode structures.

The next step is to increase the speed of the e-jet printer by incorporating hundreds of nozzles. The Illinois team is working with several companies, including Dow Corning and Ford, with a view to printing solar cells and lighting systems, respectively. —A. GOHO

CURRY POWER

An age-old seasoning could help combat Alzheimer's

BY PATRICK BARRY

Imagine that you're living 3,000 years ago in a village in what's now southern India. When you get sick or injured, you visit the healer, who most likely is a practitioner of the herbal medicine called ayurveda. For whatever ails you, you'll probably get a treatment that includes a bit of bright, yellow-orange powder, the spice turmeric.

If you have a scrape, the healer will put turmeric on it. Indigestion? Turmeric. Jaundice? Turmeric. "Nervous weakness"? That's right—turmeric.

The powder comes from a broad-leafed plant that thrives in the hot, rainy climates of southern Asia. Its pinecone-shaped stalks of white, pink, and yellow flowers smell faintly of mango, and its bulbous roots resemble those of the ginger plant, to which it is closely related. Cut a root open, however, and you'll find its fleshy interior is that vivid yellow-orange.

People in the region long ago discovered that boiling, drying, and grinding these roots produces a fragrant powder with a nutty, slightly bitter taste. People ascribed healing properties to the powder, particularly for ailments involving inflammation. Meanwhile, the substance became pervasive in regional diets as the color-giving component of most yellow curries. The widespread use of turmeric continues today in both Indian cuisine and in ayurvedic medicine.

Western medical doctors are often skeptical about traditional and herbal cures. In the case of turmeric, however, a surge of scientific research in recent years has supported at least some of the claims made for turmeric's active ingredient, a compound called curcumin. This research has shown that curcumin—available commercially as an extract—acts as both a powerful antioxidant and an anti-inflammatory agent.

It was this anti-inflammatory property that led University of California, Los Angeles researchers Greg Cole and Sally Frautschy to wonder in the mid-1990s whether curcumin might be effective against a condition that ayurvedic practitioners might not have considered: Alzheimer's disease.

An estimated 24 million people worldwide have Alzheimer's. The U.S. Food and Drug Administration has approved five drugs to mitigate its symptoms, but no FDA-approved drug exists to combat the causes of the disease.

Alzheimer's disease involves the steady deterioration of nerve cells in the brain, leading to dementia. A leading theory holds that the disease arises when a small protein in the brain gathers into toxic clumps called plaques. In this scenario, these plaques kill brain cells in part by triggering inflammation, a state of heightened immune system activity that can damage the body's own cells. The plaques also produce free radicals, which cause oxidative damage to nerve cells.

"We looked at [curcumin] and said, 'You know, here's something which is anti-inflammatory,'" says Cole. "When we saw that curcumin was also a better antioxidant than even vitamin E, we said, 'This thing has got all these properties that look good, so we'll test it,'" against Alzheimer's.

Those experiments and subsequent work by other scientists have shown that, in addition to its anti-inflammatory and antioxidant properties, curcumin has several effects that may work in tandem

to protect the brain from plaques in other ways. "If curcumin had a single [molecular] target, it probably would not be as good a drug," says Bharat Aggarwal, who studies curcumin at the M.D. Anderson Cancer Center in Houston. "But because it has multiple targets, [it's] very attractive."

COUNTING THE WAYS In the late 1990s, Cole's team screened curcumin and 11 other candidate compounds that have antioxidant and anti-inflammatory properties. The scientists tested the substances in mice that had an Alzheimer's-like condition created by infusing the plaque-forming protein, called amyloid-beta, into the mice's brains. The results were surprising, Cole says. "Amyloid-beta was reduced by the curcumin but not by these other [compounds]." Compared with mice that were fed normal diets, the animals treated with curcumin had up to 80 percent fewer plaques.

The reasons for this decrease in amyloid-beta plaques began to emerge in 2002, when Cole's team showed that, in lab dishes, curcumin inhibits amyloid-beta proteins from clumping into

plaques. Two years later, a team of researchers in Japan led by Kenjiro Ono of the Kanazawa University Graduate School of Medical Science found that curcumin not only blocks plaque formation but also weakens existing plaques in the lab and triggers their disintegration. Ono's group didn't figure out the physical mechanism by which curcumin disrupted the plaques, however.

A clue to that mechanism came from an unexpected source. It turned out that curcumin resembles molecules that scientists had been using in medical imaging to make plaques more visible in



BRIGHT FUTURE? — The yellow-orange color of turmeric powder and the root from which it's made comes from the pigment curcumin. Several recent studies have suggested that curcumin could be a cheap preventative and palliative treatment for Alzheimer's disease.

brain scans. Because of that structural similarity, curcumin also has a strong affinity for binding to amyloid-beta.

Using mice engineered to have a mutated human gene known to cause plaque, Cole's group showed in 2005 that curcumin's direct binding to the amyloid-beta protein accounts for the chemical's ability to interfere with plaque formation and to degrade existing plaques.

Ingesting curcumin can also lower a person's cholesterol. In a study by researchers at the Amala Cancer Hospital and Research Center in Amalanagar, India, people who took 500 milligrams of curcumin daily for 7 days had a 29 percent higher concentration of beneficial high-density lipoprotein cholesterol than they'd initially had, and their total blood-cholesterol concentration was an encouraging 11 percent lower.

Several studies during the 1990s found that people with unhealthy cholesterol profiles had a greater risk of developing Alzheimer's disease than did people with normal cholesterol readings. A team led by Takashi Mori of the Saitama Medical University in Japan found in 2001 that cholesterol accumulates within plaques and may help amyloid-beta proteins bundle together, suggesting that reducing cholesterol might also inhibit plaque formation in the brain.

More recently, some scientists have suggested that a person's immune system may also be involved in Alzheimer's. "Everybody is always producing amyloid-beta, but not everybody is developing the disease," says Milan Fiala of the Greater Los Angeles Veterans' Affairs Medical Center. The reason, he argues, is that immune system cells called macrophages normally patrol the brain and gobble up budding plaques. Fiala suspects that, in people who develop Alzheimer's, these macrophages aren't performing their cleanup duty properly.

That's just what he found when he tested macrophages taken from Alzheimer's patients. When placed in lab dishes with amyloid-beta plaques, these cells had almost no ability to devour the plaques, largely because of reduced activity of a gene called *MGAT3*. Adding curcumin to the dish restored the plaque-clearing prowess of about half of these macrophages and returned *MGAT3* to its normal activity, Fiala and his colleagues report in the July 31 *Proceedings of the National Academy of Sciences* (SN: 07/21/07, p. 37).

"The list of [curcumin's] effects goes on and on, and they're all in your favor," Aggarwal says.

DOWN TO THE ROOTS If curcumin really does fight the plaques that lead to Alzheimer's, shouldn't populations in which people eat a lot of turmeric-containing curry have a lower incidence of the disease?

In fact, studies in India seem to show a much lower rate of Alzheimer's disease than exists in Western, industrialized countries. For example, a 2001 comparison of sample populations of people 65 and older in Ballabgarh, India, and in Monongahela Valley, Pa., found that only 4.7 cases of probable Alzheimer's disease were diagnosed per year among every 1,000 people in India, while the comparable rate in the Pennsylvania sample was 17.5 cases—almost four times as high. The researchers, led by Vijay Chandra of the University of Pittsburgh Graduate School of Public Health, wrote that, "These are the first [Alzheimer's disease] incidence rates to be reported from the Indian subcontinent, and they appear to be among the lowest ever reported."

Of course, a curry-consuming tradition is not the only difference

between India and other countries. Some other physical or cultural trait, such as genetic differences or a relatively short life expectancy there, could account for India's low rate of Alzheimer's disease.

Some evidence suggests that a diet rich in yellow curry may indeed play a role. In 2003, Tze-Pin Ng of the National University of Singapore and his colleagues tested the mental performance of 1,010 Singaporeans between the ages of 60 and 93, none of whom had been diagnosed with any form of dementia. The researchers also surveyed the volunteers about their eating habits and found that those who reported that they ate curry "occasionally" or "often or very often" gave significantly better cognitive per-

formances than did people who claimed to eat curry only rarely, Ng's team reported in the Nov. 1, 2006 *American Journal of Epidemiology* (SN: 11/11/06, p. 316). The researchers noted that the curry typically used in Singapore is yellow curry, which is rich in curcumin-containing turmeric, rather than green or red curry.

Such studies of dementia in curry-consuming cultures are not conclusive, scientists agree, but some researchers believe that these data suggest that a link may exist between frequent consumption of yellow curry and reduced risk of mental decline from Alzheimer's.

CUPBOARD CURE? If it does prove effective against the disease, curcumin would have an important advantage over other Alzheimer's treatments under development. People can get it at the grocery store, in turmeric powder shelved in the spice aisle.

The fact that turmeric root is already sold all over the world was one of the reasons for researchers' original interest. "If we're going to have a treatment which has worldwide impact, it would need to be cheap," says Jeffrey Cummings of the University of California, Los Angeles. "So the

economics of curcumin are very fortuitous in that it is a cheap, widely available compound."

However, Cummings and others caution that the ready availability of curcumin is also one of its dangers. In the United States, the 1994 Dietary Supplement Health and Education Act allows companies to sell dietary-supplement pills containing concentrated plant extracts such as curcumin without approval from the FDA. The quality of such pills is essentially unregulated—each company is responsible for ensuring that its pills' ingredients are safe and that they contain what the company claims them to be. Although bills pending in Congress would increase FDA oversight of the supplement industry, it's currently a buyer-beware market.

Fortunately, millennia of use in food, as well as recent scientific tests, have left curcumin with an excellent safety record. Neither history nor recent research has turned up adverse health effects in people consuming reasonable amounts of curcumin, Aggarwal says.

The final word on whether curcumin actually helps prevent and treat Alzheimer's disease can come only from the gold standard of medical research: a placebo-controlled trial on people. Such data for curcumin are not yet available, but University of California, Los Angeles neurologist John Ringman is conducting a trial of curcumin in about 40 Alzheimer's patients. The trial is in its final stages, and the researchers expect to have their results prepared for publication by early next year.

In the meantime, if you want to remember to check back later on Ringman's study, it certainly couldn't hurt to add some yellow curry to your diet. ■



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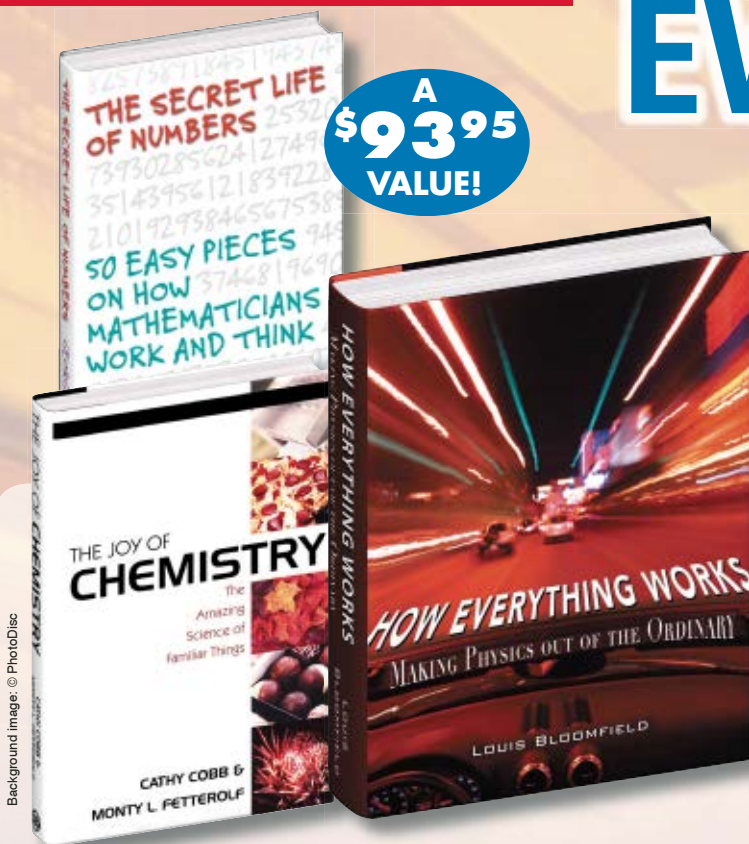
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Science News 09/15/07 LSC0709PT-03/9X

CONSCIOUSNESS IN THE RAW

The brain stem may orchestrate the basics of awareness

BY BRUCE BOWER

In October 2004, Swedish neuroscientist Bjorn Merker packed up his video camera and joined five families for a 1-week get-together in Florida that featured several visits to the garden of childhood delights known as Disney World. For Merker, though, the trip wasn't a vacation. With the parents' permission, he came to observe and document the behavior of one child in each family who had been born missing roughly 80 percent of his or her brain.

These children, 1 to 5 years old at the time of their Disney adventure, had suffered strokes as fetuses or had experienced other medical problems shortly before or after birth that destroyed nearly all of the brain's outer layer, or cortex. In this rare condition, called hydranencephaly, cerebrospinal fluid fills the gaping hole within the child's head.

Such youngsters often die in the first year of life as a result of seizures, cerebral palsy, lung abnormalities, and a variety of other physical ailments. With proper medication and the installation of shunts to drain fluid from the braincase, however, some individuals live 20 years or more.

Neurologists typically regard hydranencephaly as an anatomical sentence to a lifelong "vegetative state." Such children supposedly validate a brutally simple equation: Little or no cortex equals no awareness of any kind.

In family activities observed in the Magic Kingdom and elsewhere, the kids quickly cast doubt on that standard assumption. Merker noted that these cortex-deprived, nonverbal children remained alert for much of the day. They reacted to what happened around them and expressed a palette of emotions. A 3-year-old girl's mouth opened wide and her face glowed with a mix of joy and excitement when her parents placed her baby brother in her arms.

The youngsters displayed good hearing but limited eyesight, a curious pattern given that they typically retained small parts of the visual cortex but none of the auditory cortex.

In observations at each child's home, Merker noted that these youngsters recognized familiar adults, liked familiar settings, and preferred specific toys, tunes, or video programs. Although saddled with limited mobility, some kids took behavioral initiatives, such as learning to activate a toy by throwing a switch.

In the February *Behavioral and Brain Sciences*, Merker, an independent neuroscientist in Segeltorp, Sweden, described how the accomplishments of these children relate to behaviors recorded in prior studies of human-brain function and of animals after surgical removal of the cortex. His analysis generates a provocative proposal: Basic awareness of one's internal and external world depends on the brain stem, the often-overlooked cylinder of tissue situated between the spinal cord and the cortex.

Merker argues that the brain stem supports an elementary form of conscious thought in kids with hydranencephaly. It also contains auditory structures capable of preserving hearing in someone without a cortex. In contrast, optic nerve damage in hydranencephaly frequently impairs vision, regardless of what the brain stem does.

Self-awareness and other "higher" forms of thought may require cortical contributions. But Merker posits that "primary consciousness," which he regards as an ability to integrate sensations from the environment with one's immediate goals and feelings in order to guide behavior, springs from the brain stem.

If he's right, virtually all vertebrates—which share a similar brain stem design—belong to the "primary consciousness" club. Moreover, medical definitions of brain death as a lack of cortical activity would face a serious challenge. At the very least, physi-

"The roots of consciousness exist in ancient neural territories we share with all vertebrates."

— JAAK PANKSEPP,
WASHINGTON STATE
UNIVERSITY

cians could no longer assume that individuals with hydranencephaly don't need pain medication or anesthesia during invasive medical procedures.

"To be conscious is not necessarily to be self-conscious," Merker says. "The tacit consensus concerning the cerebral cortex as the 'organ of consciousness' ... may in fact be seriously in error."

BRAIN DRAIN The roots of Merker's thesis emerged more than 50 years ago in the operating room of Canadian neurosurgeons Wilder Penfield and Herbert Jasper. The surgeons pioneered the removal of large chunks of cortex as a treatment for severe, uncontrolled epilepsy. To identify and avoid damaging still-functional brain areas, Penfield and Jasper kept patients awake during the surgery and administered only local anesthesia.

Various mental abilities suffered during and after the operations, depending on the site and extent of the neural loss. Nevertheless, patients maintained a conscious stream of thought, Penfield and Jasper found.

In the course of electrically stimulating various brain areas during operations to identify key functional areas, they noted that current delivered to the right spots could produce every kind of seizure except one—so-called "absence epilepsy" characterized by a sudden loss of consciousness for a few seconds. On the basis of what they knew about the brain, the researchers theorized that structures within and just above the brain stem typically trigger absence epilepsy and collaborated with the cortex to regulate conscious thought and intentional acts.

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Animal research, predominantly with rats, has since indicated that three adjacent parts of the brain stem comprise a "neural reality simulator" that gives rise to a fundamental form of consciousness, Merker asserts.

Along the top of the midbrain, which represents the roof of the brain stem, layers of cells interpret the spatial layout of an animal's surroundings relative to its body. Just below, a patch of gray tissue influences emotion-related behaviors, such as aggression, sex, defensive maneuvers, and pain reactions.

Farther down the brain stem lie interconnected regions that regulate the direction of eye gaze and organize decisions about what to do next, such as reaching for a piece of food or pursuing a potential mate.

Together, these structures surround brain stem tissue that connects to sensory areas throughout the cortex.

Merker proposes that, in creatures with a brain stem but little cortex, the neural reality simulator produces a two-dimensional, screenlike map of the world featuring moving shapes. A large cortical endowment beefs up the neural reality simulator, creating an ability to perceive a three-dimensional world composed of solid objects. Neural expansion also allows people to reflect about what they think and feel.

In support of his theory, Merker cites studies conducted over the past 40 years in which rats and cats showed relatively few behavioral problems after surgical removal of the cortex, either in infancy or adulthood. These cortex-deprived animals use vision and touch to orient to their surroundings, learn where to find food in mazes, and remain capable of standing, climbing, grooming, mating, and caring for offspring.

Merker also cites an unusual phenomenon known as the Sprague effect. Complete removal of the visual cortex on one side of the brain renders animals unable to see anything in the half of the visual field opposite the surgical site. Yet a tiny cut to the midbrain restores the animal's ability to detect and approach moving entities, even though it still can't distinguish one object from another.

The Sprague effect underscores the brain stem's visual influence, Merker argues. Visual-cortex removal derails brain stem activity via numerous neural links to the midbrain's spatial cells that suddenly lack meaningful input. A well-placed midbrain cut halts activity by some of those wayward connections, allowing a partial return of sight, in his view.

Any entity with the equivalent of a neural reality simulator, "whether cast in a neural medium or eventually in silicon," would experience consciousness, Merker theorizes.

CORTICAL DIVIDE Of 27 comments by mind and brain researchers published with Merker's article, nearly half agreed that the inner workings of consciousness lie in the brain stem.

"The roots of consciousness exist in ancient neural territories we share with all vertebrates," says neuroscientist Jaak Panksepp of Washington State University in Pullman. "By the weight of empirical evidence, all mammals are sentient beings."

In his own research, Panksepp studies the ability of animals to experience biologically based states of mind or feelings that range from hunger and thirst to emotional delight and distress. For instance, Panksepp and a coworker reported in a controversial 2003 paper that rats express "joy" while playing with other rats by making ultrasonic sounds that represent an ancestral form of laughter.

Psychologist Carroll Izard of the University of Delaware in Newark emphasizes that this form of primary consciousness, as Merker would put it, or "primary affect," as Panksepp terms the rats' consciousness, consists of sensory activity in the brain stem. This capacity generates emotions and an awareness of one's surroundings but not an ability to talk about what one has experienced, Izard continues. In the same way, people can become conscious of a feeling that they can't label or describe, a phenomenon that's especially common in healthy infants and in children lacking a cortex, Izard says.

The existence of primary consciousness challenges widespread assumptions among physicians that newborns and fetuses can't feel pain, adds pediatric neurologist K.J.S. Anand of the University of Arkansas for Medical Sciences in Little Rock. Evidence now suggests that adult and immature brains use different systems to process pain, Anand says.

The brain stem and the thalamus, a relay station for sensation just above the brain stem, foster pain responses in babies before and after birth, he asserts. The cortex takes over pain perception as it greatly expands during childhood and adolescence, Anand hypothesizes.

Other investigators criticize Merker for denying the cortex its traditional position as the brain's engine of consciousness. Even if a basic form of consciousness exists, they regard it as at least a partial product of the cortex, not just the brain stem as Merker argues.

Conscious thought probably relies on the workings of connected brain areas within and outside the cortex, contend Susanne Watkins and Geraint Rees, neuroscientists at University College London. "It seems unlikely that activity in any single area of the human brain will be sufficient for consciousness," they write.

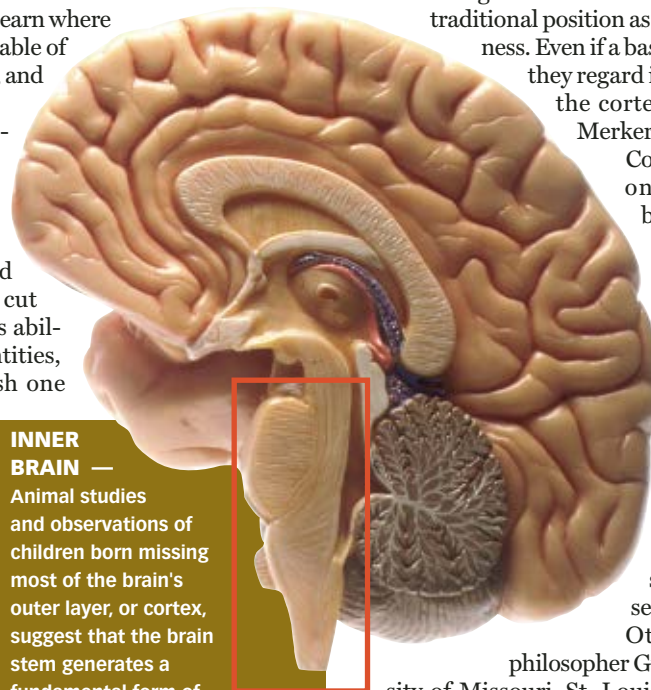
Children with hydranencephaly studied by Merker possess remnants of cortical tissue that could have triggered states of awareness, the researchers suggest.

Other commenters, including philosopher Gualtiero Piccinini of the University of Missouri–St. Louis, cite prior evidence that the cortex by itself regulates visual awareness. Following visual-cortex damage, certain patients report no conscious ability to see on one side of their visual field but still unconsciously perceive the identity and location of items in that same visual field. Scientists call this phenomenon blindsight.

The most extensively studied blindsight patient has frequently reported being aware of "something" in his blind visual field, Merker notes. This man retains primary visual consciousness of his surroundings but can't describe what he sees in words, the Swedish researcher contends.

RECLAIMED KIDS In a 1999 report, D. Alan Shewmon, a pediatric neurologist at the University of California, Los Angeles Medical Center, and his colleagues described home observations of three children, ages 6 to 17, who had been born with hydranencephaly and raised by loving, attentive parents. Each child displayed comparable signs of conscious mental activity, the researchers reported.

For instance, shortly after birth, a newborn girl's brain scan revealed an almost total lack of cortical tissue. Physicians told the girl's mother that the child would live no more than 2 years



INNER BRAIN — Animal studies and observations of children born missing most of the brain's outer layer, or cortex, suggest that the brain stem generates a fundamental form of conscious thought. Here, cutaway of a normal human brain shows the folded cortex atop the brain stem (in box).

as a “vegetable.” A neurologist concluded that the girl’s brain was “like that of a reptile” and that she would never interact with other people.

Shewmon first visited the girl at age 5, observing her behavior at home. Despite difficulty sitting up or walking without aid, she exhibited excellent health. She smiled in response to Shewmon’s friendly overtures and immediately looked at objects brought close to her. In a videotaped play session with her mother, the girl uttered “ah-ah” when encouraged to say “mama.”

She brightened upon hearing happy songs, but often cried during sad songs. She enjoyed the sensory stimulation of car rides, crying at stops and calming down as motion resumed. She disliked the loud noises of vacuum cleaners and hair dryers. She demonstrated understanding of a few words, including “bunny rabbit” for one of her stuffed toys.

“If these children had been kept in institutions or treated at home as ‘vegetables,’ there can be little doubt that they would have turned out exactly as predicted,” Shewmon says.

After making his own observations of children with hydranencephaly and their families, Merker seconds that point. He notes that well-treated youngsters born with little or no cortex regularly display brief losses of consciousness due to absence epilepsy, a clear sign that at other times they’re conscious.

Parents described these lapses of awareness in their children to Merker with phrases such as “she is off talking with the angels.”

Perhaps most intriguingly, kids with hydranencephaly demonstrate that the brain stem is not simply a reptilian relic stashed in the brain’s basement. “The human brain stem is specifically human,” Merker says. “These children smile and laugh in the specifically human manner, which is different from that of our closest relatives among the apes.”

For now, the neural puzzle of consciousness remains unsolved. But cortically endowed investigators may have much to learn from cortically deprived kids. ■



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OF NOTE

BIOMEDICINE

How platelets help cancer spread

As cancer cells migrate in the body from a primary tumor, they're chaperoned by clumps of platelets. These bloodstream particles shield the cells from damage and help them invade new tissues in the process called metastasis. Researchers have now discovered how one molecule helps tumor cells aggregate their platelet entourages.

Researchers had known that podoplanin, a protein found on the surface of many tumor cells, was involved in metastasis. But no one had found receptors for the protein on the surfaces of platelet cells, so it wasn't clear how podoplanin worked.

Katsue Suzuki-Inoue of the University of Yamanashi in Japan and her colleagues noticed a similarity between the way in which a snake toxin, rhodocytin, and podoplanin activate platelets. Activation promotes clumping and also triggers platelets to release a variety of cellular factors that can contribute to the growth of blood vessels feeding metastatic tumors.

In chemical tests and assays of tumor cells, the researchers showed that podoplanin interacts with the CLEC-2 receptor, the same receptor by which rhodocytin activates platelets. The podoplanin-receptor interaction thus appears both to protect tumor cells as they move in the bloodstream and to contribute to their growth, Suzuki-Inoue says. The team's findings appear in the Sept. 7 *Journal of Biological Chemistry*.

The new findings supply only a piece of the tumor-metastasis puzzle, she adds. But targeting the podoplanin-CLEC-2 interaction could be a strategy for new antimetastasis drugs. Suzuki-Inoue and her team are now examining how the two substances come together on the cell surfaces. —S.W.

ASTRONOMY

Major merger

Like cosmic bumper cars, four galaxies are ramming into each other in one of the biggest collisions ever recorded. The quartet will ultimately merge into a single galaxy that may be several times as massive as the Milky Way.

Kenneth Rines of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., and his colleagues spotted a fan-shaped plume of stars, 150,000 light-years long, spilling from a compact group of four galaxies in a cluster known as CL0958+4702. The cluster lies 5 billion light-years from Earth. Three of the galaxies weigh about the same as the Milky Way, while the fourth is about three times as massive.

Simulations suggest that the plume contains stars tossed out when one or more of the smaller galaxies had an earlier near-miss of a collision with the most massive galaxy. The galaxies, now about 55,000 light-years apart, are spiraling toward each other, Rines and his colleagues report in the Aug. 10 *Astrophysical Journal Letters*.

Observations from NASA's infrared Spitzer Space Telescope and the visible-light WIYN telescope atop Kitt Peak in Arizona show that the plume contains old, red stars—exactly the type expected to make up the main stellar population in old elliptical galaxies. Moreover, the colors of the galaxies themselves indicate that they contain little hydrogen gas, the raw material for making new stars.

The stars in both the plume and the galaxies probably formed during the first 3 billion years of cosmic history in smaller galaxies that merged about 7 billion years later to form the four galaxies. The ongoing collision not only documents how a giant galaxy is made, but also enables astronomers to separate the usually intertwined epochs of star formation and galaxy assembly, Rines says. —R.C.

BEHAVIOR

Perfect pitch isn't so perfect in many

People who can name a single musical note played in isolation have what is called absolute, or perfect, pitch. A new study suggests that this uncanny ability might be distorted slightly by a common routine in Western music and could fade with age.

Researchers offered an online test of pitch and tabulated the scores from 2,213 musicians who took it. In the test, a participant heard 72 1-second tones and had 3 seconds to identify each one by clicking an on-screen keyboard.

Among the responders, 981 people, ages 8 to 70, had scores high enough to indicate that they had absolute pitch, the scientists report in the Sept. 11 *Proceedings of the National Academy of Sciences*.

Curiously, the scores showed that one particular error was the most common:

Nearly half of the test takers misidentified a G-sharp. Many mistook it for an A, which is half a tone higher. Perhaps not coincidentally, in Western orchestras preparing for concerts, musicians tune their instruments to an A note traditionally played by an oboist.

Thus, A may serve as a magnet for people hearing the less common G-sharp. The note A "has a unique place in music," says study coauthor Jane Gitschier, a geneticist at the University

of California, San Francisco.

Older people fared worse than younger people on the test. While 55 of the participants got every note correct, no one over age 51 was among them. —N.S.

EVOLUTION

Advantage: Starch

New genetic evidence supports the controversial notion that the lowly tuber propelled humans to the top of the evolutionary heap.

Human saliva is rich in amylase, an enzyme that breaks starch into glucose before it's swallowed. People carry more copies of the amylase gene than their ape relatives do and in turn make more of the enzyme, according to a report online and in an upcoming *Nature Genetics*.

Nathaniel Dominy, an anthropologist at the University of California, Santa Cruz who coauthored the report, says that the findings add to other evidence that starch from tubers, corms, and bulbs provided crucial calories in the early human diet.

The study found that people carry up to 15 copies of the amylase gene. Chimpanzees, whose diets contain little starch, carry just two copies.

Moreover, people in aboriginal cultures that eat mostly meat or fish carry fewer copies of the gene and produce less of the enzyme than do nearby aboriginal people who consume lots of starch. For instance, the Yakut people of the Asian Arctic, who subsist on seafood, carry fewer copies of the amylase gene than their close genetic kin the Japanese, who get lots of starch from rice. The same pattern holds for two Tan-



SMASH! Four giant galaxies in the cluster CL0958+4702 are ramming into each other in this artist's simulation rendered from the vantage point of a nearby, hypothetical planet.

zanian tribes: The Datog, who raise livestock, have fewer copies than the Hadza, who primarily gather tubers and roots.

"This is good evidence that natural selection" favors additional copies of the amylase gene in groups that rely on starchy foods, says Dominy. —B.V.

ARCHAEOLOGY

Ancient city grew from outside in

Roughly 6,000 years ago, Mesopotamian cities in what's now southern Iraq began as central clusters of buildings and then spread as orchestrated by authorities. About the same time, a different pattern of city development occurred in northern Mesopotamia, a new investigation finds. Instead of expanding outward from a densely populated core, an ancient metropolis in what's now northeastern Syria emerged over an 800-year period as a number of settlements grew together and expanded inward toward what then became the city's core, say Jason A. Ur of Harvard University and his colleagues.

Ur's team studied the placement and age of pottery fragments and other artifacts on and around Tell Brak, a 40-meter-high, 1-kilometer-long earthen mound.

Outposts established by independent groups apparently merged as a result of their booming populations and gradual inward sprawl, creating a city with a central hub by about 6,000 years ago, the scientists report in the Aug. 31 *Science*. A contingent of all-powerful leaders did not plan Tell Brak's urban transformation, as happened in southern Mesopotamian cities, the researchers propose. —B.B.

CHEMISTRY

Nanoparticles multitask

Nanoparticles can play many roles, but they're more often used for tagging and sorting molecules rather than for participating in chemical reactions. Nanoscale

bits with magnetic properties, for instance, can enhance magnetic resonance images and can tag other molecules in chemical assays. But researchers have now shown that nanoparticles of magnetite (Fe_3O_4) can play an active chemical role with catalytic muscle applicable to wastewater treatment and biomedical assays.

The nanoparticles can catalyze the same reactions prompted by peroxidases, enzymes that can clean up wastewater and also help researchers detect small amounts of molecules in diagnostic medical assays. Though previously unknown, the chemistry of the magnetite nanoparticles makes sense, report Sarah Perrett and her colleagues at the Chinese Academy of Sciences in Beijing. The nanoparticles are comparable to a mixture of iron ions and hydrogen peroxide—known as Fenton's reagent—that oxidizes organic pollutants so that they can be removed from wastewater.

Assuming that the nanoparticles were chemically inert magnets, researchers working on biomedical assays have previously coated them with a variety of catalysts. Such catalysts produce a color change or other detectable effect by reacting with another molecule in the assay.

Perrett's team has now found, however, that magnetite nanoparticles are 40 times as effective as a commonly used peroxidase in catalyzing a reaction that turns the chemical 3,3,5,5-tetramethylbenzylidene blue. The team reports the finding in the September *Nature Nanotechnology*.

Because the nanoparticles are less fragile than peroxidases, they could be used under pH and temperature conditions that would

destroy the enzymes. Utilizing both the magnetic and catalytic properties of the nanoparticles could streamline biomedical assays, Perrett says.

She and her colleagues have already designed such an immunoassay. "The assay would be worth developing commercially, because it is cheaper, faster, more direct, and potentially more sensitive," Perrett says. —S.W.

ASTRONOMY

Bloated planet

Imagine a planet nearly twice the diameter of giant Jupiter, yet puffy enough to float on water. Discovered by a team led by Georgi Mandushev of the Lowell Observatory in Flagstaff, Ariz., this alien orb is both the largest and the lowest-density planet yet found in the cosmos.

As seen from Earth, the planet periodically passes in front of its parent star, blocking about 1 percent of the starlight. Observations of several of these mini-eclipses, known as transits, along with the timing of the orbit, reveal that the planet has a diameter 1.67 times that of Jupiter but only 84 percent of its mass, putting its density close to that of balsa wood. Jupiter, the solar system's largest planet, has about six times that density. The bloated body, dubbed TrEs-4, lies some 1,435 light-years from Earth.

Residing closer to its parent star than one-tenth Mercury's distance from the sun, TrEs-4 is heated by intense starlight to a blistering 1,600 kelvins, the team reports in an upcoming *Astrophysical Journal Letters*. Further study will reveal whether the planet has an extended atmosphere like that of the much-studied, transiting planet HD 209458b. Because of TrEs-4's weak gravity, some of the planet's atmosphere may be escaping in a cometlike tail. —R.C.

BIOMEDICINE

Blood vessel growth factor also does housekeeping

The growth of new blood vessels, a process known as angiogenesis, is spurred by a molecule called vascular endothelial growth factor (VEGF). Scientists had thought that VEGF's role was mainly to carry messages between cells, but new research shows that VEGF also acts within the cells lining normal blood vessels to keep them alive and functioning correctly. The finding may explain certain vascular side effects of cancer drugs that silence VEGF in order to inhibit blood vessels that feed a growing tumor.

M. Luisa Iruela-Arispe and her colleagues at the University of California, Los Angeles developed a strain of mice that can't produce VEGF. Most of these mice died by early adulthood—about 25 weeks—and had vascular problems, including symptoms similar to those of a heart attack.

Lacking VEGF, the cells lining normal blood vessels died prematurely, the researchers report in the Aug. 24 *Cell*. But adding VEGF to the cells didn't restore normal function, the team also found.

Although the researchers didn't test the impact of antiangiogenesis drugs in this study, Iruela-Arispe says that "long-term blockage of [VEGF] may have long-term consequences that we did not foresee a few years ago." She's quick to emphasize, however, that these potential side effects don't outweigh the potential importance of anti-angiogenesis drugs in fighting cancer. —S.W.



URBAN SPREAD Broken pottery and other remains of the outer city at Tell Brak lie in an irrigation trench, within an area now consisting mainly of agricultural fields and sheep pastures.

Books

A selection of new and notable books of scientific interest

THE FIRST WORD: The Search for the Origins of Language

CHRISTINE KENNEALLY

Few human abilities are more remarkable than the capacity for language. Attempts to elucidate language's origins have been thwarted, however, by the absence of fossils or recordings of the primitive forms of human communication. Linguist and journalist Kenneally looks at recent developments that make it easier to trace the origin and evolution of language. She summarizes studies of thought and communication patterns in other animals, such as the numerical abilities of monkeys. She compares communication patterns in animals such as dolphins with patterns in humans. She examines the development of the basic features of oral and written language, such as words and syntax, as well as the coordination of tongue and lips that makes speech possible. She looks at the role of evolution in the development of genes for language. Finally, Kenneally anticipates the course of future debate over language's origins. **Viking, 2007, 357 p., hardcover, \$26.95.**

THE (FABULOUS) FIBONACCI NUMBERS

ALFRED S. POSAMENTIER AND INGMAR LEHMANN

The mathematician Leonardo de Pisa, who lived in the Middle Ages and is more commonly known as Fibonacci, had an enormous influence on Western civilization. His contributions include introducing Arabic numerals, algorithms and algebraic methods, and a new facility in fractions. He achieved fame, however, as a result of his observations about the regeneration of rabbits—a phenomenon resulting in a set of numbers known as the Fibonacci sequence. The pattern starts with two 1s and generates succeeding terms by adding the last two numbers to arrive at the next one. Mathematicians Posamentier and Lehmann describe the remarkable power of this simple sequence. Fibonacci numbers even appear in the stock market, they note. The authors discuss the history of the Fibonacci numbers, their relationship to the golden ratio, and their applications to physics, architecture, and music. Particularly intriguing is their relationship with fractals. **Prometheus, 2007, 385 p., b&w illus., hardcover, \$28.00.**

NEW THEORIES OF EVERYTHING

JOHN D. BARROW

Barrow, a cosmologist and mathematician, expands on his book *Theories of Everything*, published 15 years ago, in this new look at the quest to explain the secrets of the universe. He combines principles of modern physics with cultural and spiritual explanations of the nature of the universe. He touches on the notion of time, the concept of constants and

whether or not they exist, and the effects of chaos on the search for a unifying theory. He also summarizes string theory, the expansionary model of the universe, and the notion of multiverses (universes other than our own). He touches on topics as wide ranging as how nature is organized, the effects of observation on what's being observed, and the wisdom of trying to use mathematics to explain the universe. He acknowledges the limitations of seeking a formula to describe the emotional aspects of experience and the necessity of incorporating these variables into the long-sought-after theory of everything. **Oxford, 2007, 260 p., hardcover, \$29.95.**

BEYOND AI: Creating the Conscience of the Machine

J. STORRS HALL

Machines that have the capacity to outsmart humans, and thereby take over civilization, have long been the subject of science fiction. As artificial intelligence (AI) advances, supersmart machines may become reality. Today, robots can already drive cars, play soccer, and locate information on the Web. What will tomorrow's machines be able to do? And will designers eventually need to consider the consciences of the machines that they create? Hall, a renowned computer scientist, delves into these questions and others, outlining the possibilities that arise when scientists strive to build machines that think like people do. He reviews the history of AI and cybernetics, beginning with early attempts to automate logical processes, manipulate information, and model thought. He envisions machines with the ability to learn from experience or to draw conclusions. Finally, he considers the ethical and moral consequences of AI. **Prometheus, 2007, 408 p., hardcover, \$28.00.**

THE BEST AMERICAN SCIENCE WRITING 2007

GINA KOLATA AND JESSE COHEN, EDS.

Science writing has always benefited from its cutting-edge and often controversial subject matter, Kolata explains, making choosing the best writing from any given year a daunting task. This anthology, the eighth in a series, features articles drawn from such publications as *Esquire*, *The New York Times*, *Science*, and *Wired*. Among the 20 selections is a piece on lie detection by Robin Marantz Henig. Also included is an essay by Oliver Sacks, who writes about a patient who acquired stereoscopic vision late in life. A descendant of Charles Darwin, contributor Matthew Chapman brings a unique perspective to his piece on the celebrated 2005 court case centering on efforts by the Dover, Pa., board of education to add intelligent design to the public school curriculum. With other pieces dealing with such issues as medical ethics and global warming's effects on butterflies, this collection reflects the range of contemporary scientific inquiry and the skilled writers who cover it best. **Harper Perennial, 2007, 333 p., paperback, \$14.95.**

LETTERS

Talk talk talk

"Hidden Smarts: Abstract thought trumps IQ scores in autism" (*SN*: 7/7/07, p. 4) didn't mention that traditional IQ tests are in one sense "language" tests. The Ravens test doesn't involve language processing in a typical manner. A person with a language disorder, as an autistic person is assumed to be, would do better on a non-verbal test. That the intelligence of autistic people can be underestimated is really due to the fact that our culture assumes that language skill equals intelligence. **TAMMY BUSH, SAN FRANCISCO, CALIF.**

Troubled thoughts

"Trouble in Paradise" (*SN*: 7/7/07, p. 8) concerning schizophrenia in Palau reported a high incidence of the disorder among first- and second-generation immigrants to the West from developing countries. Could the phenomenon of relatively successful immigrants to the West (or their children) being drawn into acts of terrorism be a manifestation of schizophrenia? **ROBERT E. HUBBARD, WINTER HAVEN, FLA.**

Schizophrenia isn't generally associated with violent behavior. —B. BOWER

I would expect a society with expert seafaring skills to remove frightening individuals to their own island, much as England sent convicts off to Australia. The effect would be a greatly increased concentration of inherited emotional illnesses, regardless of the stress.

BEN NORTHRUP, LEE, MASS.

Smoke screening

"Smoke This: Parkinson's is rarer among tobacco users" (*SN*: 7/14/07, p. 20) says that "there may be some fundamental difference in susceptibility to nicotine addiction between people who develop Parkinson's and those who don't." If so, how would you explain the fact that "after smokers stubbed out their last butts, the protective effect faded"? Tobacco smoking is becoming unpopular, and for good reason, but I hope the "evil" of tobacco smoking will not stop scientists from at least considering that there might be some benefits to it. Many drugs are poisons.

MICHAEL SUSKI, OTTAWA, ONT.

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