

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

MARCH 8, 2008 PAGES 145-160 VOL. 173, NO. 10

h₂s: secrets of a smelly gas
colon screening—beyond polyps
dating the grand canyon
supernova's first sparks spied

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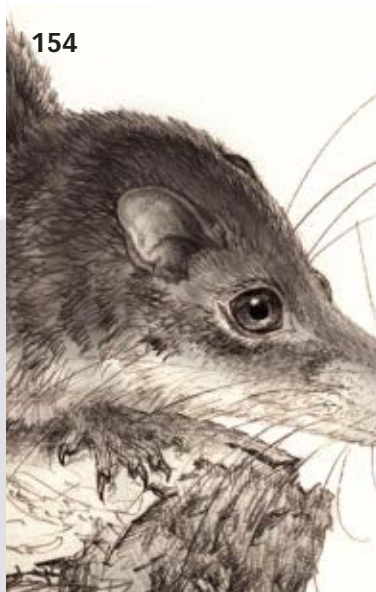
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Cover Pictured is an artist's rendering of *Akidolestes cifellii*, an insect-eating primitive mammal whose fur and bones were excavated from 124.6-million-year-old rocks in China. Discovered in 2006, *Akidolestes* is but one of many recent fossil finds rocking traditional views about the evolution of early mammals. (Mark A. Klingler/Carnegie Museum of Natural History) **Page 154**

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Cancer Risk

Colon growths might not be so obvious

The fight against colorectal cancer, by most accounts, is going well. With colonoscopy, doctors can prevent most of these malignancies by detecting and removing polyps, growths along the colon that can be precancerous. But some people who have had polyps removed or who have gotten a clean checkup still get diagnosed as having colorectal cancer a few years later.

A new study suggests that these out-of-the-blue cancers may arise from nonpolyp growths. Such tissues are less conspicuous than polyps, but the new data suggest that they occur with some regularity and might be more dangerous than polyps.

Researchers in Japan first noticed nonpolyp growths in colonoscopies during the 1980s and 1990s. The growths were typically flat patches of colon or rectal lining that were reddish and slightly deformed, showing patterns of disrupted blood vessels. As with polyps, some of these tissues showed abnormal growth, and Japanese doctors have since devised an easy technique for removing them during a colonoscopy.

But in the 1990s, scientists in the United States and Europe failed to find many such growths or to perceive a risk from them. Many wrote off nonpolyp growths as unique to Asians, says Roy Soetikno, a gastroenterologist at the Veterans Affairs Palo Alto Health Care System in California.

Soetikno and his colleagues performed colonoscopies in 2003 and 2004 on 1,819 veterans, predominantly white males with an average age of 64.

To discern nonpolyp growths, the U.S. physicians relied on instructions and training videos from Japanese doctors. All polyps and nonpolyp growths in the participants were removed and tested in a lab.

The physicians removed at least one colorectal polyp or nonpolyp growth from three-fifths of the veterans. Most growths were neoplastic, a grouping that includes precancerous tissues and very early cancers that haven't moved past the lining of the colon or rectum. Overall, 10 percent of the veterans



GRAND OLD HOLE Analyses of mineral formations in caves along the Grand Canyon hint that parts of the chasm may be 17 million years old.

had neoplastic, nonpolyp growths, the researchers report in the March 5 *Journal of the American Medical Association (JAMA)*.

"It is now clear that Asian and Western populations may develop [nonpolyp growths]," says physician David Lieberman of the Oregon Health & Science University in Portland, writing in the same *JAMA* issue.

Some patients had as many as 10 growths removed. While polyps outnumbered nonpolyp growths, lab analyses showed that the nonpolyp kind was at least five times as likely to be cancerous.

In recent years, Western scientists have debated whether colonoscopy or CT scans detect polyps better (*SN: 12/6/03, p. 355; 5/1/04, p. 285*). "It is possible, if not likely, that additional [nonpolyp growths] may be missed by both," Lieberman says.

"It takes some training to make [detection] automatic," Soetikno says. Doctors are more likely to check for these growths if patients insist on it, he says. "This is contrary to the prior dogma." —NATHAN SEPPA

Ancient Chasm

Parts of Grand Canyon may be 17 million years old

Studies of mineral formations found in caves in the walls of the Grand Canyon and nearby may provide fresh insight into the chasm's history, including its age and the rate at which it was carved.

Many of these caves contain mammillaries, mound-shaped lumps of carbonate minerals that typically form just below the surface of mineral-rich pools. Thus such deposits mark the level of the local water table, says Carol Hill, a geologist at the University of New Mexico in Albuquerque. If the water table drops—due, say, to changes in climate

or tectonic movements of Earth's crust—the formation will be left high and dry. By measuring the concentrations of uranium and lead in a deposit's outer layers, researchers can estimate when its pool dried up.

Hill and her colleagues analyzed mammillary formations from nine caves near the Grand Canyon. Most of the caves lie within a few kilometers of the Colorado River, the waterway that now flows through the chasm. Also, the deposits that the researchers sampled came from elevations no more than 1.2 km above the modern river level, says Hill. The researchers presume that ancient changes in the region's water table are linked to drops in the river level as it scoured deeper into the region's rocks.

Analyses of one mammillary from the western Grand Canyon region suggest that when the deposit stopped growing some 17 million years ago, the water table stood about 1,160 meters above today's river level. Other analyses from that region indicate that by 7.6 million years ago, the water table had dropped to 930 m above the modern river level. About 2 million years ago, the water table was only 120 m higher than it is now, leading researchers to infer that during that interval the Colorado has scoured the western reaches of the canyon downward by that amount. Overall, rates of downward erosion in this region have averaged between 55 and 123 m per million years during the past 17 million years, Hill and her colleagues report in the March 7 *Science*.

Analyses of cave mammillaries in the eastern Grand Canyon region suggest that the Colorado's downward scouring there began much later but has occurred at dramatically faster rates. In that area, the water table—and, presumably, the river level—has dropped about 920 m in the past 3.7 million years, at average rates between 166 and 411 m per million years.

Together, the cave-formation data sug-

gest that erosion of the Grand Canyon began at its western end and proceeded upstream, says Hill.

Hill and her team “have compiled an excellent record of local water tables dropping” but their assumptions about the region’s geology may be incorrect, says Joel L. Pederson, a geomorphologist at Utah State University in Logan. Water tables aren’t always flat over large regions of complicated topography, he notes. Moreover, decreases in the water table inferred for the oldest of the cave formations might have been linked to the carving of canyons that predate the Grand Canyon. —SID PERKINS

Supernova Outbreak

X rays signal earliest alert

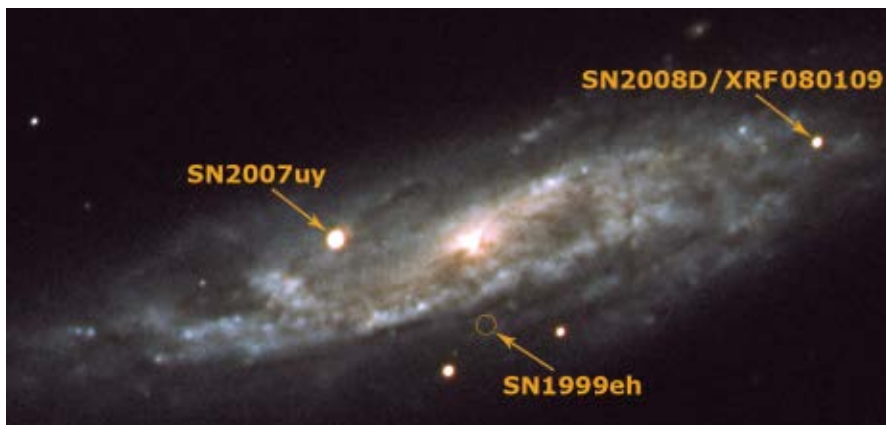
Thanks to a lucky break and an overactive galaxy, astronomers have for the first time caught a massive star in the act of exploding. An X-ray outburst recently recorded by NASA’s Swift satellite suggests that researchers began viewing the violent demise of a star in the galaxy NGC 2770 just a few seconds after the first X rays arrived at Earth, and hours before the first visible-light fireworks.

Most supernovas aren’t identified until they generate an outpouring of visible light, long after key information about the collapsing star has vanished. The new finding suggests that astronomers using wide-angle X-ray telescopes could routinely witness the very beginnings of hundreds of supernova explosions each year, suggest Alicia Soderberg and colleagues in an online posting.

Such early, X-ray signs of supernovas have been predicted for 4 decades but never before been found.

On Jan. 9, Soderberg and her colleagues were using an X-ray telescope on Swift to study a supernova in NGC 2770 that had been discovered 10 days earlier. Just as Swift began observations of this supernova, it recorded a fresh spike of X rays from another region in the galaxy that lasted for about 7 minutes. On Jan. 11, using the Gemini North telescope on Hawaii’s Mauna Kea, Soderberg and her colleagues identified the visible-light fingerprint of the new supernova, now dubbed SN 2008d, in NGC 2770.

Soderberg, of Princeton University and the California Institute of Technology in



BANG Astronomers serendipitously found the supernova SN 2008d, located in the galaxy NGC 2770, through X-ray observations (labeled as XRF080109). This observation marks the first finding of signs of a stellar explosion emitted so soon after a star’s demise.

Pasadena, and her team posted the findings at <http://xxx.lanl.gov/abs/0802.1712> on Feb. 13. They declined comment because they have submitted the article to *Nature*.

The team suggests that the outburst reflects the nature of the star that exploded. When stars more than eight times the sun’s mass succumb to gravity, their interiors collapse, giving birth either to a neutron star or to a black hole. Tens of seconds after the collapse, a shock wave reaches the still unperturbed surface of the star and the region just beyond. It’s in this relatively low-density environment that the energy locked inside the shock can finally be released as high-energy radiation, or X rays.

From the energy and duration of the initial X-ray release, the researchers suggest that the exploded star was compact but surrounded by a substantial stellar wind, hurled out before it went supernova.

Observing a supernova so early in the game shows “what the progenitor star [was like] just before the explosion,” comments Roger Chevalier of the University of Virginia in Charlottesville.

Even these early X rays arrive seconds after other emissions—specifically, neutrinos and gravitational waves that emerge from the supernova’s core, notes Andrew MacFadyen of New York University. However, an early X-ray alert would allow researchers to rapidly, if retroactively, determine when and where to look for these crucial, core emissions. This ability offers the strongest promise for revealing the inner workings of supernova explosions. —RON COWEN

Riff Riders

Brain scans tune in to jazz improvisers

It would come as no surprise to the late saxophonist and improvisational master John Coltrane, but when accomplished jazz

musicians play free-form, their brain activity suggests a release of self-expression from conscious monitoring and self-censorship.

Such neural activity may lie at the heart of musical improvisation and perhaps other improvisational feats, propose auditory scientist Charles J. Limb of Johns Hopkins Hospital in Baltimore and neurologist Allen R. Braun of the National Institute on Deafness and Other Communication Disorders in Bethesda, Md.

“What we think is happening is that when you’re telling your own musical story, you’re shutting down neural impulses that might impede the flow of novel ideas,” says Limb, himself a trained jazz saxophonist.

Moreover, jazz musicians immersed in improvisation display heightened brain activity in all sensory areas and in adjacent motor regions, the researchers say. Improvisers’ brains “ramped up” to translate incoming sensations into novel musical performances, Limb suggests.

For the new study, published online Feb. 27 in *PLoS ONE*, the researchers recruited six professional jazz pianists. Limb and Braun designed a plastic keyboard for the musicians to prop on their laps and play while lying inside a functional magnetic resonance imaging (fMRI) machine. They heard what they played through in-ear speakers.

By measuring rises and falls in the rate of blood flow throughout the brain, fMRI indirectly reads increases and decreases in neural activity in different brain regions.

In one exercise, pianists first played notes of the C-major scale in order, then improvised a melody with the same notes.

In a second exercise, musicians first played a memorized jazz composition note-for-note while listening to a recorded jazz quartet accompaniment. Pianists then improvised tunes while listening to the same background music.

Both exercises stimulated comparable brain activity unique to improvisation, the researchers say. The part of the frontal brain that has been linked to planning and self-

A. DE UGARTE POSTIGO (ESO) AND OTHERS, DARK COSMOLOGY CENTRE/UNIV. COPENHAGEN, INSTITUTO DE ASTROFÍSICA DE ANDALUCÍA (CSIC), AND UNIV. HERTFORDSHIRE

ensorship saw a marked decline in activity. At the same time, activity spiked in a small frontal structure that has been linked to being able to tell a story about oneself.

The researchers plan to look for the same frontal responses during improvisation by other types of artists, such as poets or painters. Even the ability to converse in one's native tongue is unscripted and may depend on the brain's improvisational mechanisms, Limb proposes.

Further research could help determine whether the observed frontal responses contribute to altered states of consciousness often reported during jazz improvisation.

Neuroscientist Fredrik Ullén of the Karolinska Institute in Stockholm regards the widespread deactivation of planning-related frontal areas during jazz improvisation as "the most fascinating new finding." In a 2007 fMRI study of classical pianists, Ullén found more frontal-brain activation during improvisation than Limb and Braun did. However, classical pianists lack the improvisational experience of jazz pianists, he says. —BRUCE BOWER

Aging Factor

Gene mutations may be key to long life

Juicing up with growth hormones may build muscles, but probably won't help you live to see 100 candles on your birthday cake, a new study suggests.

A study of 384 aged Ashkenazi Jews shows that a decrease in insulinlike growth factor 1 (IGF-1) activity is associated with long life, Nir Barzilai and his colleagues report in the March 4 *Proceedings of the National Academy of Sciences*.

For a decade, Barzilai has studied centenarians, a rare group of people who live to be 100 or older, looking for genes that contribute to longevity. But he never expected IGF-1, or growth hormone, would be involved, says Barzilai, director of the Institute for Aging at the Albert Einstein College of Medicine in New York City.

Practitioners of antiaging medicine tout IGF-1 as a youth-restoring treatment because it helps firm skin and build muscles. The substance is good for the heart, brain, and bones, stimulating stem cells to replace damaged cells, says Jan Vijg of the Buck Institute for Age Research in Novato, Calif. Reducing IGF-1 activity in people was thought to lead to diabetes, heart disease, and other illnesses.

Reducing growth factor activity dramatically lengthens the life of nematodes, fruit flies, and other animals, but many scientists thought the pathway played no role, or had the opposite effect, in human aging.

But when Barzilai and his colleagues tested blood levels of IGF-1 in children of

centenarians, the researchers found that daughters of centenarians had altered levels of the growth factor compared to the control group. These daughters were also, on average, 2 centimeters shorter than those in the control group.

Neither the centenarians nor their younger counterparts (the control group) had mutations in the gene encoding IGF-1. The mutation was instead in the IGF-1 receptor, which the hormone binds to in order to trigger a signal that, ultimately, tells cells to grow. Nine centenarians—both women and men—and one person in the control group carried this mutation, which reduced the growth hormone's activity.

Mutations in the receptor may extend life by helping people avoid cancer, Vijg says. "Osteoporosis and heart disease you may be able to live with, but cancer, I don't think so. You just die."

It may take more than a single mutation to achieve a very long life, says Cynthia Kenyon, a molecular biologist at the University of California, San Francisco. Several different factors may determine life span in humans, she says. "We don't know how complicated it is."

Taking growth hormone likely won't lengthen life, Vijg says. "You may do great at the gym lifting weights, but you may not live any longer."

No one knows whether lowering growth factor activity late in life will increase longevity either. —TINA HESMAN SAEY

Black Hole of Light

Laser pulses create model of event horizon

If you've ever drifted so close to a waterfall that you could no longer swim fast enough to get away, then you pretty much know what it's like to fall into a black hole. Researchers have now created a laboratory analog of such a point of no return.

"Space-time really behaves like a river," says Ulf Leonhardt of the University of St. Andrews in Scotland. "Gravity can be represented as if space were a medium that is flowing." A swimmer's best efforts correspond to nature's ultimate speed limit, which is the speed of light in empty space.

Black holes are regions where gravity curls space-time so much that nothing inside can escape—think of a waterfall that would trap all swimmers, no matter how fast. Both a spaceship approaching a black hole (or a swimmer edging toward a waterfall) will cross a point of no return called an event horizon. That's where space-time flows into a black hole's region so fast that even light cannot escape.

In their experiment, Leonhardt and his colleagues created the optical analog of an event horizon. To do so, they exploited the fact that inside matter, light travels slower than in empty space, and at varying speeds. They piped different laser beams simultaneously down an optical fiber. One—playing the role of the river—was a pulse lasting 70 trillionths of a second, and traveling relatively slowly. This pulse was also able to slow other light waves crossing its path.

A second beam—playing the role of the swimmer—initially traveled slightly faster than the first. The light waves of this beam would almost catch up with the pulse, but



Promiscuous orchids

Some orchids use sexual deception to entice a pollinator, mimicking the scent of a specific female wasp, for example. This plant-pollinator monogamy maintains genetic isolation and prevents undesirable pollen from clogging up the works. But other orchids mimic nectar-bearing flowers, inviting a variety of visitors. These plants need a back-up plan to maintain species integrity. Several Mediterranean species in the genera *Orchis* (pictured is *O. mascula*), *Anacamptis*, and *Neotinea* keep the gene pool clean by thwarting reproduction after pollination. Crossing experiments reveal that embryos didn't develop, or if they did the hybrid plants were sterile, which is unusual for orchids, report Salvatore Cozzolino of the University of Naples Federico II in Italy, and colleagues in the March *American Naturalist*. "The type of deception you adopt has strong consequences," Cozzolino says. —RACHEL EHRENBURG

then get slowed down so much by it that the light waves would fall behind.

The experiment, reported in the March 7 *Science*, showed that the “swimmer” waves were unable to get into the event horizon, rather than unable to escape it. Thus, it produced not a black hole event horizon, but its opposite, called a white hole. However, Leonhardt says that the pulse behaves like a black hole if the swimmer waves start out traveling slightly slower than the pulse.

Either way, the researchers hope that the optical event horizon will allow them to detect a kind of radiation similar to what Stephen Hawking of the University of Cambridge in England predicted for black hole event horizons in 1974. Hawking suggested that pairs of photons can pop out of empty space as the result of quantum fluctuations outside the event horizon, and one photon out of each pair shoots away, essentially making the black hole glow. Future experiments might produce analogous radiation from the optical event horizon.

“This opens the possibility to make the final step and see ... Hawking radiation,” says Grigori Volovik, a theoretical physicist at Helsinki University of Technology in Finland. —DAVIDE CASTELVECCHI

A Way Forward

Releasing the brakes on cancer vaccines

Scientists have tried for decades to create vaccines that spur a cancer patient’s immune system into attacking tumors, but cancer cells cleverly defuse the attack. Research in mice now suggests a new way to overcome these defenses and rally the immune system to action.

Previous attempts to defeat tumor defenses with a vaccine caused dangerous side effects by provoking the immune system to attack healthy cells indiscriminately. The new technique is the first with the potential to selectively bolster the immune system’s attack on tumor cells while sparing healthy cells.

“This is not like inducing the whole immune response,” says Xiao-Tong Song of the Baylor College of Medicine in Houston. Getting an immune response that’s specific to tumor cells is difficult, Song explains. Tumors protect themselves by hijacking the immune system’s own generic “stop” signals. Simply blocking these stop signals lets

the immune system run out of control and attack any cell it finds.

Normally, an intricate balance of stop-and-go signals keeps immune cells in check. Some cell types, such as dendritic cells, release go signals while they show the “attack dog” cells characteristic pieces of the cancer cells—much like letting a bloodhound sniff a fugitive’s socks. The attack cells should then kill only the cancer cells.

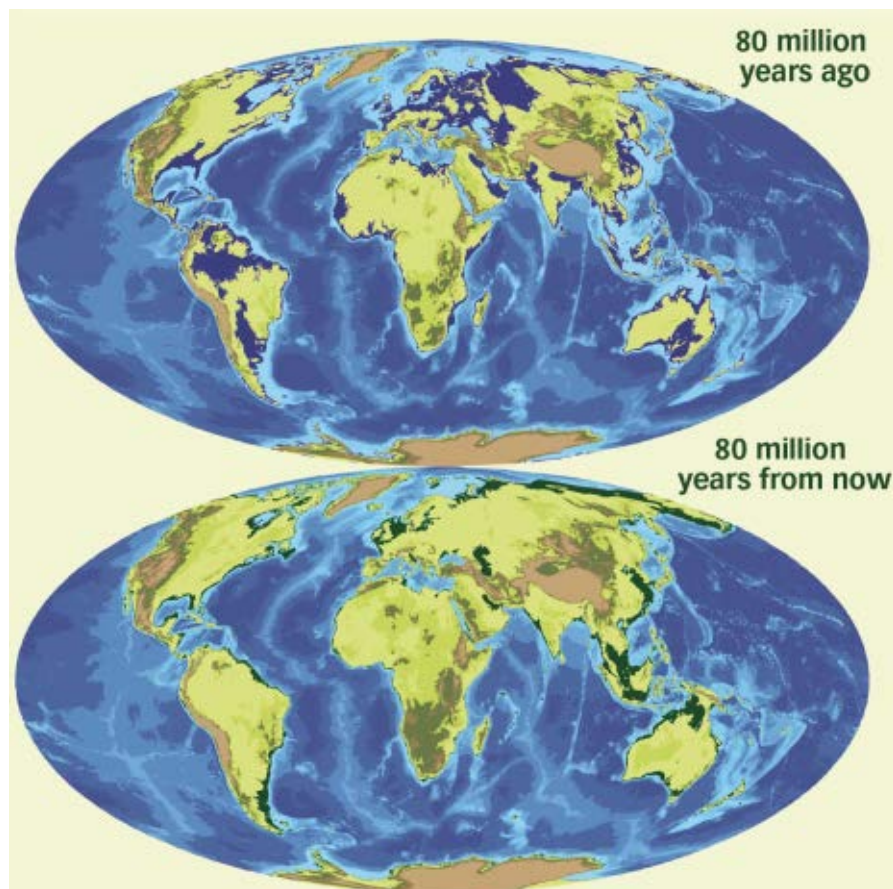
Stop signals released by regulatory T cells (T-regs) calm the attack cells. Unfortunately, tumors recruit and harbor T-regs to placate would-be attackers, so a major goal of cancer-vaccine research has been to stimulate dendritic cells and weaken T-regs.

Song and his colleagues extracted dendritic cells from mouse bone marrow and grew the cells in lab dishes. The researchers revved up these dendritic cells by exposing them to a typical cancer molecule. They also added an engineered virus

that blocked the cells from making a protein called A20.

Their results showed that blocking A20 boosted dendritic-cell activity: When the scientists injected the treated cells back into mice with early melanomas, the cells released more go signals than normal. The overactivated attack-dog cells killed tumor cells in spite of the T-regs. Early tumor growth was stymied just as well in mice that had their T-regs reduced. Also, after a month, the mice receiving the treated dendritic cells had no apparent signs of side effects from autoimmunity, the team reports online and in an upcoming *Nature Medicine*.

The research “provides us with a new understanding of how to manipulate dendritic cells to achieve a more active immune response,” comments Louis M. Weiner of the Lombardi Comprehensive Cancer Center at Georgetown University in Washington, D.C. —PATRICK BARRY



Ocean ups and downs—the long view

About 80 million years ago, no land-based ice sheets existed. Also, a larger proportion of the world’s ocean crust rode higher than now on underlying mantle, so oceans were shallower. Computer models suggest that sea level then was about 170 meters higher than today, says R. Dietmar Müller, a geophysicist at the University of Sydney. Many areas that are now dry, including northern Europe, were covered with shallow seas (dark blue areas, top map). If, overall, ocean basins continue to drop as expected, 80 million years from now sea levels will have dropped another 120 m, exposing vast swaths of continental shelf (dark green areas, bottom map), Müller and his colleagues report in the March 7 *Science*. If today’s ice sheets melt, sea level will drop only 70 m. —SID PERKINS

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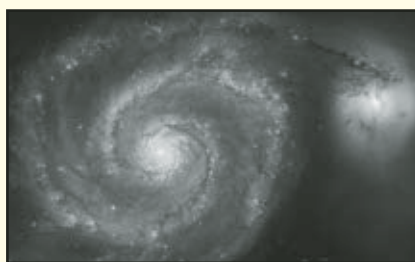
A natural teacher with a Ph.D. in astrophysics from Columbia University, Dr. Neil deGrasse Tyson has written prolifically for the public, including the series of essays in *Natural History* magazine on which this course is based. And though it was created for a lay audience and is readily accessible, the course is one in which science always takes precedence over drama.

It is certainly entertaining, often funny, even awe-inspiring at times, as befits the subject matter. But clear introductions to essential principles of physics abound throughout these lectures, including density, quantum theory, gravity, and even the General Theory of Relativity. And Dr. Tyson also includes forays into disciplines such as chemistry and biology as needed to explain events.

For example, Dr. Tyson begins one lecture at a point 13 billion years ago, when all space, matter, and energy in the known universe was contained in a volume less than one-trillionth the size of a pinpoint—about the size of an atom. By the time he finishes, the cosmos has been

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The Whirlpool Galaxy, as seen by the Hubble Space Telescope, is about 25 million light-years away from us.

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ROTTEN REMEDY

Hydrogen sulfide joins the list of the body's friendly, if foul, gases

BY JEANNE ERDMANN

Hydrogen sulfide deserves its bad reputation. It's famous for filling the air of high school chemistry labs with the smell of rotten eggs. One strong whiff of the noxious gas can knock you to the ground. Too much can kill you.

Aside from its odorous infamy, hydrogen sulfide, or H_2S , has long been considered biologically unimportant. But it turns out that H_2S produced in the body manages many major biological functions. Some preclinical data show that H_2S can ameliorate the side effects of anti-inflammatory drugs. And just last December, scientists reported that relatively high doses of H_2S extend the life span of the minute roundworm *Caenorhabditis elegans*. Perhaps, such research suggests, the Fountain of Youth is a chamber of that stinky gas.

In fact, it now seems, you can't live without H_2S . At the same time, true to reputation, its effects are not always benign. In recent years scientists have compiled growing evidence that H_2S can both harm and help the body, influencing aspects of biology from immunology to inflammation to cell proliferation. H_2S affects illnesses spanning hypertension, diabetes, atherosclerosis, and neurological disorders, including strokes. Figuring out how H_2S wields such power will provide insights into basic biology, could suggest therapeutic agents for many diseases, and may explain why garlic protects the heart.

Scientists have known for decades that the body produces H_2S but didn't realize its importance beyond its toxicity. Then a new story about the body's gases began in the early 1980s, with the discovery that nitric oxide, or NO, performed the job of helping cells communicate. Years later, a second bodily gas, carbon monoxide, or CO, revealed its ability to transmit signals between cells as well. These gases and other substances were christened "gasotransmitters." H_2S is the most recent member to join the club.

"Gasotransmitters show a new way for scientific discovery to unveil the secrecy of ourselves," says Rui Wang of Lakehead University in Thunder Bay, Ontario, Canada. "This is a revolution and it's just beginning."

Wang first encountered H_2S around 1989 during graduate work at the University of Alberta. A toxicologist wanted to understand why leaks of that gas from oil fields posed such a quick danger to oil workers.

By 1996, scientists had begun to understand that the amount of H_2S in the body is important. For example, they had figured out that both low and high doses of H_2S could affect nerve cells. It occurred to Wang that this gas could join the gasotransmitter family. And then all sorts of questions popped into his head. "Why do we make H_2S ? If we are what we smell, then why aren't we smelly?" he remembers wondering.

To answer those questions, workers in Wang's lab isolated the gene for CSE (cystathionine-lyase), an enzyme that regulates H_2S levels in mammals (except in the brain, where the enzyme doing that job is cystathionine-synthase).

Other scientists had already found CSE in organs such as the liver, indicating that cells had a mechanism to produce H_2S . Wang's team cloned the CSE gene from vascular smooth muscle cells and found it to be identical to the CSE previously cloned from the liver. He reasoned that if blood vessels also produce the enzyme for making H_2S , cells in blood vessels must need daily doses.

Wang's team then investigated rats and cultures of aortic cells to understand what H_2S concentrations do to the cardiovascular system. The work, published in the *EMBO Journal* in 2001, showed that the presence of H_2S in a rat's circulatory system relaxed cells in the aortic tissue and lowered the rat's blood pressure—but only when the H_2S concentration occurred in the natural range.

The team also figured out that H_2S opens a type of potassium channel, a group of proteins anchored on the cell membrane that provide a pathway for potassium ions flowing in and out of the cell. This flow signals the cell to do something: contract, secrete, or move.

"Gasotransmitters show a new way ... to unveil the secrecy of ourselves."

— RUI WANG,
LAKEHEAD UNIVERSITY,
ONTARIO, CANADA

GOOD GAS, BAD GAS

Research about H_2S started with understanding toxic effects from environmental exposure. Now, studies are looking inside, aiming to understand why the body makes its own H_2S , and why that H_2S can have both positive and negative effects.

For instance, rat studies show a connection between elevated H_2S levels and diabetes.

In rat cells that mimic human pancreas cells, high levels of H_2S suppress insulin secretion. Because people with type 1 diabetes—the genetic form—make a lot of the enzyme CSE, thereby elevating H_2S , Wang speculates that too much H_2S can partially explain why people with type 1 diabetes don't release insulin. H_2S effects may thus help explain the origins of diabetes itself.

In other areas, the effects of H_2S are more mixed. Some animal studies show a relationship between H_2S and the brain in cases of ischemic stroke—the kind with the blood clot. Whether the connection is helpful or harmful remains unclear.

Inflammation also exemplifies both sides of H_2S . Philip K. Moore, now of King's College London, and his team were first to show that H_2S worsened inflammation in mice. In work published in the *Journal of the Federation of American Societies for Experimental Biology* (FASEB), the team injected mice with lipopolysaccharide (LPS), a toxic component of some bacterial cell walls, to induce inflammation in lungs. Moore's team could lessen inflammation in the lungs and liver by preinjecting mice with DL-propargylglycine, a chemical that blocks CSE. To find a more direct link between high H_2S and worsened inflammation, the team injected mice with sodium hydrosulfide (NaH_2S), essentially adding H_2S to the body. Injecting NaH_2S worsened inflammation to the same degree LPS did.

Other work, published by Moore and his collaborators in the January 2008 issue of *Shock*, reveals the anti-inflammatory side of H₂S. This project showed that H₂S protects lung function in mice with pancreatitis (an inflamed pancreas). People with bad cases of pancreatitis also suffer lung inflammation.

And in animals with the equivalent of inflammatory bowel disease, giving H₂S-releasing drugs can reduce inflammation.

So it's not clear whether H₂S is pro-inflammatory or anti-inflammatory. "This sounds odd, but the same is true for nitric oxide, which can be both," comments Moore. "It may simply be that high levels of H₂S are pro- and low levels are anti-inflammatory, but I would bet it would turn out to be more complex than that."

NEMATODES LOVE H₂S While sorting through the good and bad effects of H₂S on inflammation will help both basic science and therapeutics, David Roth of the Fred Hutchinson Cancer Research Center in Seattle has his sights on the Fountain of Youth.

Roth never wondered much about H₂S. He manipulates oxygen metabolism to put animals in suspended animation. He stopped the metabolic rate of nematodes and fish so that they didn't consume oxygen and didn't produce carbon dioxide.

He could suspend fish and worm metabolisms and bring them back again by incrementally removing and then adding oxygen. But for an animal as large as a mouse, removing oxygen would be lethal. So he put mice in a hibernationlike state by lowering oxygen demand. For that he needed something toxic. He settled on H₂S.

H₂S could help mammals survive an otherwise lethal lack of oxygen, Roth showed in work published in *Shock* in April 2007. Exposing mice to H₂S reduced their ability to use oxygen by a factor of 10, which in turn reduced their heart rate and their breathing rate and slowed their movement to a state of deep hibernation. The mice survived this way for 6 hours with no behavioral defects.

"I thought, 'Well jeez Louise, if you can do that, why not do that for people who are suffering their own problems, such as having no blood in their bodies because they were just shot by someone in Iraq?'" Roth recalls.

Indeed, the U.S. military thought so too, and the Defense Advanced Research Projects Agency, or DARPA, funded Roth to use rats to mimic a battlefield situation. Roth saved the rats under certain conditions of blood loss by exposing them to H₂S and lowering their need for oxygen.

Roth wants to extend the rat work to the battlefield and help injured soldiers. He patented a way to bottle H₂S as a liquid for intravenous use. Soldiers with severe blood loss could be treated with an IV of H₂S, possibly lowering their need for oxygen until enough blood could be transfused. The work is in clinical trials in Australia.

Roth's current work, published in December 2007 in *Proceedings of the National Academy of Sciences (PNAS)*, suggests that beyond battlefield healing, H₂S has Fountain of Youth possibilities.

To dissect genetic pathways allowing H₂S to help animals survive a lethal lack of oxygen, Roth and colleagues turned to the roundworm *C. elegans*. They grew the nematodes from larvae to sexual maturity and beyond in a chamber of 50 parts per million H₂S, the OSHA limit in which people can work for

8 hours a day. Since *C. elegans* is barely larger than the period at the end of this sentence, at the very least Roth figured that the worms would be sluggish, just like the mice.

But instead, the worms wiggled. They reached sexual maturity and produced offspring at the same rate per hour as did animals raised in room air. They withstood high heat.

And they lived 70 percent longer than worms raised in room air. Why? "I don't know the answer to that yet," Roth says.

The paper does hint at a mechanism. Worms raised in H₂S and that lacked the *SIR-2* gene, or silent information regulator number 2, had life spans matching their room-air counterparts. Michael Crowder, of Washington University Medical School in

St. Louis, says that *C. elegans* helped researchers establish the link between *SIR-2* and life span regulation of multicellular organisms.

ALWAYS A SMELLY LEGACY

Roth and others are optimistic that H₂S compounds will save lives and produce anti-inflammatory drugs with relatively few side effects, but it's still early for basic research on H₂S. Researchers need to figure out how H₂S fits in among the thousands of mediators that contribute to inflammation. Mammals constantly produce H₂S and both of its regulating enzymes. Researchers need to know—on a real-time basis—what triggers the enzymes to release H₂S. Researchers also want to know whether this release could be controlled.

Complicating matters, H₂S easily diffuses anywhere in the body and likely works through a variety of mechanisms. Also, depending on the circumstances, cells can be exposed to H₂S alone or in combination with

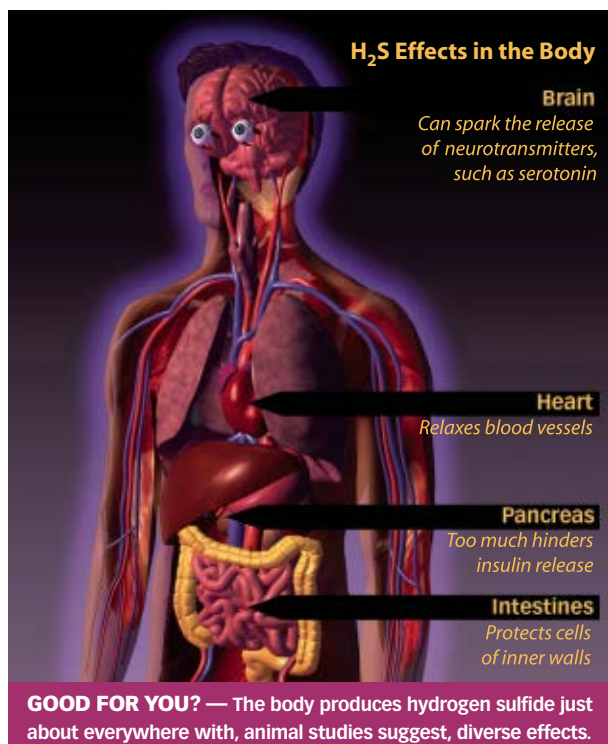
NO or CO, so scientists need to figure out how these gases work together. Also, some work shows H₂S may affect genes. How many genes, and whether H₂S does so alone or in combination with other gases, is unknown. An accurate way of monitoring real-time releases of H₂S from single cells would give scientists exact amounts of H₂S surrounding cells. "For H₂S there really is no accurate way of checking the levels in the precise environment of a cell," says Moore of King's College. With accurate measurements of a single cell, scientists could determine any differences between what happens in a single cell and then what occurs in the same cell type in the body.

David Kraus and his colleagues at the University of Alabama at Birmingham developed their own sensor that measures H₂S in solutions mimicking real cellular conditions. They used this sensor to figure out how H₂S and garlic work with red blood cells to protect the heart.

Researchers already knew that garlic compounds and H₂S provide similar benefits in the heart—for example, preventing clots and lowering blood pressure. In work published in December 2007 in *PNAS*, Kraus' team used its new sensor to watch the garlic compounds be converted into H₂S as soon as they came in contact with red blood cells.

"It occurred to us that the cardiovascular effects of the garlic compounds may be mediated by H₂S, so we had to show that the garlic compounds were metabolized into H₂S. When we did that, we found that the effects of the garlic compounds were identical to those of H₂S," says Kraus. Which just further goes to show that whether it's beneficial or detrimental, H₂S remains stinky. ■

Jeanne Erdmann is a freelance writer in Missouri.



TWICE UPON A TIME

Jaw fossils point to multiple origins of the most mammalian of features

BY AMY MAXMEN

Tom Rich has an eye for finding bits of skulls in unlikely places. In January, he and his team reported finding a slight groove in a half inch-long jaw. Using a modified CT scanner, the researchers scrutinized the fossil they had unearthed in Australia a few years earlier. Reviewing the images of the jaw's structure, Rich and collaborators saw the groove and realized they held what remained of a duck-billed platypus out of place in the age of dinosaurs.

The jawbone's groove gave away its owner's identity because living platypus bills bear notoriously wide grooves equipped with nerves to sense their prey in fresh water. But this grooved jaw belonged to a platypus from a time when mammals supposedly were all simple, shrewlike creatures that scurried around the shadows of *T. rex*. Platypuses, however—mammals with rubbery duck-bills, water-repellent fur, beaver-like tails, and webbed feet—certainly aren't plain.

In the past decade, new fossil finds have contradicted long-held views of the simplicity of primitive mammals. They seem to have been just as motley and specialized for life on the land or in water as today's mammals are. This emerging view of mammal history suggests not only that complex features evolved millions of years earlier than previously thought, but also that they might have evolved independently in different groups.

For centuries, related animals have been defined by "key innovations" that presumably allowed lineages thereafter to diversify. But some researchers now believe that these defining characteristics might actually have been commonplace and thus relatively easy to achieve—challenging the long-held notion that, as Yale paleontologist Jacques Gauthier asserts, "Complicated systems do not evolve willy-nilly."

Reports of advanced early mammals, such as Rich's platypus, suggest otherwise. The most contentious recent findings even downgrade the refined mammalian middle ear and ridged molars to less than novel. Though no reptile or other vertebrate has ever evolved these intricate hearing and chewing apparatuses, some rabble-raising paleontologists allege that they popped up multiple times within the mammals.

It's a controversial idea: Evolutionary biologists invoke parsimony when they assume the fewest number of changes occurred during animal history, unless fossil evidence indicates otherwise. Kangaroos, wallabies, and wombats—all marsupials—bear a pouch, and so do their fossil relatives. So biologists infer that a marsupial ancestor acquired the pouch once, not three separate times. Since the fossil record is incomplete, there has been every

reason to think for nearly a century that complicated structures, like the molar and middle ear, evolved one time. Not many.

Tremors shaking the old consensus began ten years ago with digs in the Southern Hemisphere, in hard-to-mine, remote lands in Antarctica and Australia. Before then, fossils of the earliest ancestors of two of the three surviving mammalian lineages had been found in Northern Hemisphere fossil beds. Dating to 144 to 119 million years ago (early in the Cretaceous period) these two lineages include the placental group, who nourish their young in a uterus through a placenta (dogs, whales, and humans are examples), and the pouch-bearing marsupials. Since members of both groups birth live young, paleontologists inferred that the groups descended from a common ancestor on the northern supercontinent Laurasia, which broke apart to form Asia, Europe, North America, and Greenland. And, millions of years later, some individuals from either line made their way south.

That was the accepted story until 1997, when Rich and his colleagues, working in southeastern Australia, dug up their first contentious jaw—a 120 million-year-old fossil belonging to a mammal named *Ausktribosphenos nyktos*. Though the jaw measured barely over half an inch, its features led the team to describe *Ausktribosphenos* as an early placental mammal. Finding a fossil of a placental mammal in the Southern Hemisphere dating back to the early Cretaceous, cast doubt on the Laurasian northern-origin hypothesis, Rich, of the Museum Victoria in Australia, and his colleagues reported in a 1997 *Science* paper.



ALL IN A JAW — Furrows in this jaw of an extinct platypus, *Teinolophos trusleri*, stir debate over how many times the same complex innovations evolved during mammalian history.

BIG BITE What really challenged existing thinking, however, was a hefty molar embedded in the lower jaw of *Ausktribosphenos*. It was the type of tooth that distinguishes modern marsupials and placental mammals from other mammals. Yet 120 million years ago, most mammals didn't have molars. The teeth on most fossil jaws from this time were pointed. Crocodilelike, the teeth swiped past one another like blades on a pair of scissors, slicing crunchy bugs.

But *Ausktribosphenos*' tooth was clearly—and problematically—the modern crushing molar, Rich reported. Until this find, it was thought that molars developed later. Over time, the pointy back teeth would fuse in a triangular pattern, forming thicker teeth with raised projections where the apex of points used to be. The projections in upper teeth interlocked with the lower teeth, like pestles into mortars. Once formed, the elaborate teeth, called tribosphenic molars, could crush, pulverize, and grind. Mammals with this molar could munch on plants or animals.

Yet, here was *Ausktribosphenos*' advanced molar, a defining trait

in modern placental and marsupial lineages. Could it have developed an advanced feature, and then millions of years later, given rise to mammals in the north with less-pronounced molars?

Suspicious of the ramifications of Rich's claim, Zhe-Xi Luo, a paleontologist at the Carnegie Museum of Natural History in Pittsburgh, questioned whether the fossil truly belonged in the placental group. After all, Rich's identification was based on jaw details alone. To reinvestigate where *Ausktribosphenos* fits in the mammalian family tree, Luo and others analyzed the relationships among living and extinct mammals having the mortar-and-pestle-type molars. The scientists constructed a new tree by measuring similarities in 55 features preserved in the teeth and jaws of 21 modern and fossil specimens. Two distinct clans of mammals bearing the crushing molars emerged from the analysis, published in *Science* in 2001. One clan included *Ausktribosphenos* and two other molar-bearing fossils from the Southern Hemisphere, along with the monotremes—furry Australian egg-laying mammals that include the platypus and spiny anteater.

The second clan comprised fossils from the Northern Hemisphere and the placental mammals and marsupials. Thus, according to Luo's analysis, *Ausktribosphenos* wasn't in the same group as placental mammals after all.

The finding cleared up one problem, but introduced another. If the tree was correct, the molar thought to belong exclusively to live-bearing mammals had evolved separately in the egg-laying monotremes. Perhaps the crushing molar appeared to have only evolved once because of evidence.

Luo's team then suggested the unthinkable: Egg-layers had independently evolved a molar that was similar to that of other mammals. By the time modern platypuses and spiny anteaters arose without adult teeth, the biting evidence was buried in the past.

Not everyone is convinced. Regarding Luo's finding of repeated origins of the molar, Tim Rowe of the University of Texas at Austin says, "I find that there's room for a different interpretation." Disagreements often ensue when whole animals are defined by a handful of eroded bones or cracks in jaws. Paleontologists determine age by signs such as cracks in the skull. If bones are missing, incompletely formed features like molars could come from either an evolutionarily primitive adult mammal or from a juvenile, Rowe says.

MORE THAN ONCE Despite such objections, recent reports by Rich, Luo, and a handful of paleontologists have gone further, saying that the middle ear, the very hallmark of all true mammals, was obtained by different groups, rather than by one common ancestor.

Only mammals have evolved the finely tuned architecture that characterizes the middle ear, composed of three tiny bones embedded in the skull by the eardrum. Scientists think the structure evolved from the jaw. An exquisite series of fossils along the path from reptiles toward mammals shows step-by-step changes in reptilian jaw bones. Less refined bones at the rear of the reptilian jaw can transmit sound. And in mammal-like reptiles, those bones became smaller and progressively moved back toward the skull. Next, they became loosely attached to the remaining, and enlarged, major jaw bone. In true mammals, middle ear bones are free from the jaw, allowing for acutely sensitive hearing. Paleontologists debate not whether the bones originated from the reptilian jaw, but rather how many times the bones separated from it.

Enter again: Rich's team's jaw, *Teinolophos trusleri*, the Australian platypus. Years before the researchers had scanned for the jaw's finer characteristics, they reported finding a trough by the jaw joint in a 2005 *Science*. Cynodonts, extinct mammal-like reptiles that gave rise to true mammals, bore just such a trough. In it, their incompletely formed middle ear bones sat attached to the jaw bone. Seeing the same thing in a sophisticated mammal meant that the ear bones of the true mammalian ancestor must not have been fully disconnected from the jaw. The group concluded that the middle ear must have broken off from the jaw twice—after egg-laying and live-bearing mammals split off from a common ancestor.

"We suddenly had a clear indication that the middle ear didn't evolve once in this perfect stage where everything separated from the jaw in one clean sweep. In fact, there were earlier, cruder

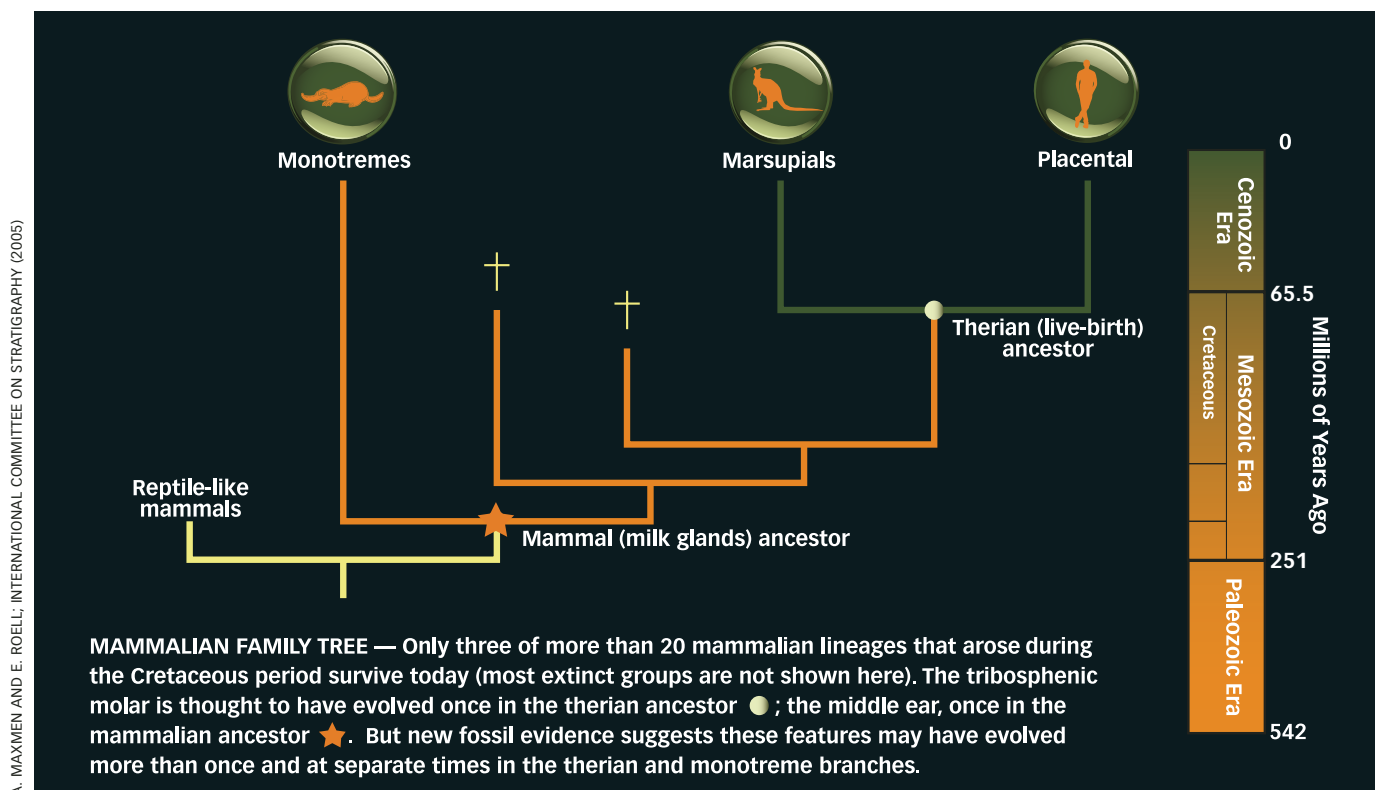
"A minor alteration during embryonic development could have led to a major innovation."

— ZHE-XI LUO
CARNEGIE MUSEUM
OF NATURAL HISTORY



odonto, extinct mammal-like reptiles that gave rise to true mammals, bore just such a trough. In it, their incompletely formed middle ear bones sat attached to the jaw bone. Seeing the same thing in a sophisticated mammal meant that the ear bones of the true mammalian ancestor must not have been fully disconnected from the jaw. The group concluded that the middle ear must have broken off from the jaw twice—after egg-laying and live-bearing mammals split off from a common ancestor.

"We suddenly had a clear indication that the middle ear didn't evolve once in this perfect stage where everything separated from the jaw in one clean sweep. In fact, there were earlier, cruder



stages, in which the middle ear functioned but it wasn't a perfected system," says James Hopson, of the University of Chicago and one of Rich's co-authors.

In response, Guillermo Rougier and two other paleontologists issued a swift criticism in a following issue of *Science* in 2005 in which Rich's team published the finding. Rougier, at the University of Louisville in Kentucky, has since seen high-resolution CT scans of the *Teinolophos* jaws and says the supposed trough does not exist. "Read it and weep," he says. "I'm relieved to see that such an intricate system didn't evolve multiple times."

Rowe, who scanned *Teinolophos*, agrees with Rougier. He says, "The pieces [of the jaw] are broken, they're stained, they're small and mounted on a pin. It's easy to overinterpret."

GROWING THE TREE Yet evidence for the multiple origins hypothesis continues to grow. In a report in *Nature* last March, Luo and three colleagues described a slim bit of hardened cartilage connecting the middle ear bones to the jaw in a 125 million to 122 million-year-old primitive mammal from China. The team noted that the middle ear bones of some embryos of living mammals are transiently attached to the jaw in a similar way. The bridge in both the adult fossil and in embryos indicates one mechanism that might account for how the separation could have occurred multiple times. A minor alteration during embryonic development could have led to a major innovation, Luo says, and it could have predictably happened in multiple unrelated groups.

"This is a mechanism by which evolution operates," Luo says. "By a change in developmental timing in some lineages, you end up with different structures."

Back in the lab, scientists have found that minor genetic tweaks during embryonic development can indeed lead to major alterations in adult appearance. In turn, those changes can be amplified by natural selection over time. "In studying development, we get better appraisals on why some features appear quite fast in

the fossil record," says developmental biologist Jukka Jernvall. At the University of Helsinki, Jernvall's experiments have shown how tooth shape can be predicted in mice. He anticipates a finite number of outcomes based on the behavior of a set of molecules that control tooth formation. One small change in the amount of an inhibitory molecule at an embryonic stage can snowball into a major change in adult appearance and function. Jernvall has

made mouse teeth tinier than usual by slightly increasing an inhibitor at a crucial moment. And he has made mice toothier with lower levels of the inhibitor. Developmental biologists haven't yet uncovered an analogous process in the middle ear, Jernvall says.

Meanwhile, paleontologists continue to scour unexcavated lands. Rich, for example, has journeyed to the northwestern block of Saudi Arabia where four-legged fossils from the age of the dinosaurs remain hidden in sand.

It's little wonder the textbooks can't keep up as fossil oddities continue pushing the origins of supposedly advanced features back in time. Since 1979, more than 200 new mammals have been discovered from fossil finds in rocks dating back to the Mesozoic Era (248 to 65 million years ago), Luo reports in the Dec. 13, 2007 *Nature*.

While all the new fossils have led to some disagreements, they also bring paleontologists closer to elucidating the true tree of mammalian ancestry. If paleontologists knew this, deciding whether the ear or molar evolved more than once would be a trivial matter of seeing who had the feature and whether or not they had a recent ancestor in common.

Astonished with new finds, Rowe says, "It's been a wealth of riches we never expected." ■

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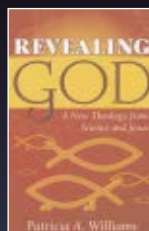
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Dr. Patricia A. Williams is the award winning author of *Doing without Adam and Eve: Sociobiology and Original Sin*. A philosopher of science, her specialization is evolution. She wrote four books, edited three collections of essays, and produced numerous articles. She taught at universities in Australia, Canada, and the United States.

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GENETICS

Eau de fruit fly

A single scent moves female fruit flies to swoon and males to flee. The difference, new research shows, is in the brain's wiring.

Male flies on the prowl put out a pheromone called *cis*-vaccenyl acetate (cVA) that both sexes detect with scent-sensing cells on their antennae.

To explain how cVA prompts such different reactions in male and female flies, researchers traced the circuitry of the cells connecting the antennae to the brain. In the brain, the cells branch out and make connections with other neurons. The researchers discovered that wiring between the cVA-detecting cells and the brain is different in males than in females.

This difference may affect how the cVA message travels through the brain, enabling the flies to react to pheromones with sex-specific behaviors, says Robert Datta, a neuroscientist at Columbia University in New York. He and colleague Maria Luisa Vasconcelos led the study, which appeared online in *Nature* Feb. 27.

A gene called *fruitless* determines mating behavior and controls the wiring of the cVA-sensing cells. Females genetically engineered with the male version of *fruitless* turn to prudes, uninterested in mating. Their brains resemble those of male flies. Male flies without the gene court other males, and their cVA-sensing brain cells take on the female pattern. —EWEN CALLAWAY

SEDIMENTOLOGY

Manifest dirt

Nineteenth-century settlers left a dusty mark on the West. Rocky Mountain lake deposits reveal that America's westward expansion kicked huge amounts of dirt into the air—probably from livestock grazing.

A team led by Jason Neff, a biogeochemist at the University of Colorado in Boulder, examined soil cores from the beds of tiny mountain lakes in Colorado's San Juan Mountains. The cores captured soil and dust deposited in the lake over 5,000 years. The chemical makeup of the cores was nothing like the surrounding bedrock, suggesting that the dirt came from hundreds of kilometers away, Neff says. Win-

ter winds are known to blow dust from California and Nevada deserts to Colorado.

Carbon and lead dating revealed that, after the 1800s, the average annual amount of dust deposited was 500 percent more than before that time, the team reports in the March 12 *Nature Geoscience*.

The spike appears around the time ranching boomed across the West, as cattle and sheep munched on erosion-protecting plants. The Taylor Grazing Act of 1934 limited ranching, and Neff's team noted a subsequent drop in dust levels.

The dust hasn't settled. The past 100 years saw a jump in deposits of chemical fertilizer, which might disturb the delicate alpine ecosystem, Neff says. —E.C.

IMMUNOLOGY

Fungi aid immune system's fight

Scientists have discovered that white button mushrooms, the plain Janes of edible fungi, are actually quite stimulating. Their powder seems to jump-start the immune response of cells taken from mice, a new study finds.

Researchers had already found that feeding mice white button-mushroom powder cranked up the activity of natural killer cells, an execution squad of the immune system. In the new study, a team led by nutritional immunologist Dayong Wu of Tufts University looked into the effect of white button-mushroom powder on dendritic cells derived from mouse bone marrow. Dendritic cells engulf suspicious foreign molecules and tidily repackage them for presentation to T cells so that T cells can later recognize the bad molecules themselves.

The young dendritic cells in the presence of the mushroom powder matured faster than cells without powder, the researchers report in the March issue of the *Journal of Nutrition*. The team also added mushroom powder to dishes of mature dendritic cells that were exposed to a foreign bit of protein. T cell activity in these cultures accelerated, suggesting that the dendritic cells were busily teaching the T cells their foreign targets, says Wu.

The revved-up immune response may be triggered by polysaccharides in the

mushroom's cell wall, perhaps because the starches aren't present in animal cells, the researchers speculate. Future studies will further investigate the immune response of mice that have eaten the mushrooms. And Wu? He prefers portabellas, a dark strain of the same species, *Agaricus bisporus*, which are harvested after their brown gills open. "Especially barbecued," he says. —RACHEL EHRENBERG

BIOMEDICINE

Raising doubts about Crohn's treatment

The conventional drug regimen prescribed for people with Crohn's disease might not be the best strategy, a new study shows.

Crohn's disease is marked by inflammation and ulcers in the intestines. It has no cure, but patients often get relief from corticosteroids, such as prednisone, the standard medication for flare-ups. If those don't work, doctors frequently turn to the anti-inflammatory drug infliximab (Remicade) and a slow-acting immune suppressor called azathioprine.

Although steroids are the standard first choice, they have side effects that include weight gain, easy bruising, swelling, and even osteoporosis.

To test whether the treatment order should be reversed, researchers randomly

assigned 65 people in the throes of a Crohn's attack to get the infliximab-azathioprine combination first. If patients hadn't recovered after several weeks or months doctors prescribed steroids, depending on an individual's status.

A group of 64 other Crohn's patients received the conventional treatment—steroids first, followed later by the other two drugs only if needed.

After 6 months, 60 percent of those who initially received infliximab and azathioprine were free of Crohn's disease symptoms, while only 36 percent of those getting steroids first were. This difference held up through 1 year, researchers report in the Feb. 23 *Lancet*.

Infliximab neutralizes an inflammation-causing protein called tumor necrosis factor alpha. This protein regulates "a common inflammation pathway that just



MUSHROOM MIGHT Adding white button-mushroom powder to incubating immune system cells from mice revved up the cells' development and their response to a foreign protein.

happens to be important in Crohn's disease," suggests study coauthor Geert D'Haens, a gastroenterologist at Imelda General Hospital in Bonheiden, Belgium.

Results due out later this year from a larger study might clarify whether the standard treatment for Crohn's patients should change, he says. —NATHAN SEPPA

SCIENCE AND SOCIETY

Encyclopedia of Life starts online—at times

The project to create an online Encyclopedia of Life with a Web page for every species has taken its first, baby steps.

The free-access, scientifically vetted encyclopedia, headquartered at the Smithsonian Institution in Washington, D.C., opened its first portal to preliminary Web pages (www.eol.org) Feb. 26. Some 11 million hits in the first few hours swamped the site. Even days afterward, users had to keep trying for a first look.

Viewers who persist will see basic information on all 30,000 of the world's fish species. The scientific nomenclature, ranges, descriptions, and often, pictures, come from FishBase, a database created and maintained by scientists. Planners of the encyclopedia say that devising such browser-friendly portals to scientists' data is what will make the new site reliable, and possible (*SN*: 2/2/08, 72).

The new site also features 25 demonstration pages, examples of what is planned for the full-grown encyclopedia. On these pages viewers can vary the amount of detail displayed, see photos of cacao flowers, learn which World War II Japanese plane was named for the peregrine falcon, and click through to scientific journal citations about the genetics of extremely elongated tomatoes. —SUSAN MILIUS

ENVIRONMENT

Some corals buffered from warming

Some western Pacific corals seem to be weathering global warming. Despite a warming ocean, reefs off Micronesia, Polynesia, and Melanesia suffered relatively little bleaching in the past 25 years, new research suggests.

Bleaching occurs when symbiotic algae living inside corals die, robbing the reefs of nutrients, color, and life. Seawater temperatures just a degree above normal can spur bleaching.

A team led by Joan Kleypas of the National Center for Atmospheric Research in Boulder, Colo., tracked changes in tropical-ocean temperatures and instances of notable coral bleaching around the world. The already balmy waters of the western Pacific warm pool (WPWP)—a swath the size of Australia—have heated little since 1950, and the corals living there have stayed healthy, the team reports in the Feb. 9 *Geophysical Research Letters*.

Even as atmospheric carbon dioxide levels climb, the reefs in the slow-warming waters of WPWP might continue to escape bleaching, says Kleypas. With warming effects blunted, efforts to reduce other stresses on the corals could make a dent there, she says.

The study jibes with other research suggesting that oceans have a built-in upper limit, or thermostat, keeping areas like the WPWP from warming much further. One proposal for an ocean thermostat claims that upwelling from the deep ocean keeps sea-surface temperatures in check, says Raymond Pierrehumbert of the University of Chicago. Unfortunately, continued increases in carbon dioxide levels would eventually quell the thermostat's effects, he says. —E.C.

MEETINGS

American Academy of Forensic Sciences
Washington, D.C.
Feb. 18–23

FORENSICS

Calling all clues ...

Add flip-open cell phones to the list of crime-scene items that might harbor a suspect's DNA.

After seeing media coverage of a crime in which a suspect had bled on a cell phone that he later dropped, Meghan J. McFadden, a molecular biologist at McMaster University in Hamilton, Ontario, wondered whether normal phone use would leave detectable traces of DNA. So she and colleague Margaret Wallace of the City University of New York analyzed the flip-open phones of 10 volunteers.

First, the researchers swabbed the surfaces of the phones in two spots: one on the outside, where the phone was held during use, and one near the ear speaker, which would be somewhat protected when the phone was folded shut. Then, they scrubbed the phones with a solution of 95 percent alcohol and returned them to the volunteers. One week later, McFadden and Wallace again swabbed the phones for DNA.

From each swab, researchers recovered DNA consistent with that of the

phone's owner. Samples taken from the outside of the phone typically produced a more complete DNA profile but also included genetic sequences that didn't match the owner, possibly some that belonged to other people who had handled the phone.

Surprisingly, says McFadden, even the swabs rubbed on a phone immediately after it was supposedly cleaned with high-strength alcohol yielded DNA—a sign that suspects probably wouldn't be able to use a simple scrubbing to destroy all the genetic material left on a phone. —SID PERKINS

REMOTE SENSING

Finding mass graves from on high

Aerial surveys that scan the ground at many wavelengths, some visible and some not, may offer a way to quickly and easily detect clandestine mass grave sites.

During field tests in Costa Rica, Mar-

garet Kalacska, a remote-sensing analyst at Simon Fraser University in Burnaby, British Columbia, and her colleagues buried several slaughtered cattle—a weight approximately equal to that of eight adult humans—in a hole 5 meters square and 1.5 m deep. In smaller holes nearby, they buried single carcasses. Yet another hole was filled with nothing but soil.

One month later, team members scanned the sites from a high-flying jet at narrow bands of wavelengths ranging from 400 nanometers (blue light) to 2,500 nm (shortwave infrared radiation). The carcass-containing plots clearly stood out from other areas, especially at some infrared wavelengths, Kalacska says. Ground-based observations indicate that those differences, probably related to subtle chemical changes in the soil over the carcasses and in the vegetation that eventually grows there, persisted throughout the 16-month test.

Kalacska and her colleagues will continue to monitor the faux grave sites to determine how long they remain readily detectable. Similar field tests in other environments will ascertain whether the multiple-wavelength technique could be widely applicable, she adds. —S.P.

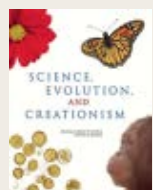
Books

A selection of new and notable books of scientific interest

SCIENCE, EVOLUTION, AND CREATIONISM

NATIONAL ACADEMY OF SCIENCES AND THE INSTITUTE OF MEDICINE

Accepting evolution doesn't mean losing one's religion, assert the authors, a diverse group of experts. "Science and religion are different ways of understanding," they write. "Needlessly placing them in



opposition reduces the potential of both to contribute to a better future." Intended to be accessible to the lay reader, the book offers a comprehensive picture of the scientific evidence from anatomy, DNA, and fossils for the theory of evolution by natural selection. It also emphasizes

why teaching the subject is so important. Without knowledge of evolution, understanding how bacteria evolve resistance to antibiotics or identifying emerging diseases such as severe acute respiratory syndrome (SARS) would be impossible. Based on 150 years of evidence in clear support of the theory of evolution, the majority of scientists no longer question the basic facts of evolution as a process. The authors argue that religion must be excluded from the science classroom. **National Academies Press, 2008, 70 p., color photos & illus., paperback, \$12.95.**

VENOMOUS ANIMALS OF THE WORLD

STEVE BACKSHALL

Decked out in flashy warning colors, many of the most venomous animals are often the most glamorous. As a result, this book featuring large-format photographs of more than 60 pain-inflicting creatures is visually stunning. Backshall, a biologist who appeared in nature shows on the BBC and the Discovery Channel, stars in a number of action shots: staring down a deadly puff adder, hand-feeding a stingray, handling a tiger snake, and more. He gives a

firsthand account of his experiences—like the time a Mozambique spitting cobra drenched his protective goggles with a jet of venom—as well as a summary of each animal's biology, distribution, and venomous status. Though more snakes are venomous than not in Australia, Backshall attempts to allay readers' fears with statistics. More people in that country die each year from horse-riding accidents, he writes, than from snakebites. **John Hopkins Univ. Press, 2007, 160 p., color photos, hardcover, \$35.00.**

WELCOME TO YOUR BRAIN: Why You Forget Your Car Keys but Never Forget How to Drive and Other Puzzles of Everyday Life

SANDRA AAMODT AND SAM WANG

The human brain is more like a crowded Chinese restaurant than a computer, write neuroscientists Aamodt, editor in chief of *Nature Neuroscience*, and Wang, of Princeton University. Whereas computers

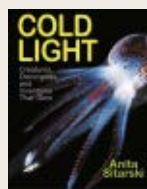
process information sequentially, the brain handles multiple channels of information in parallel. Packed with billions of neurons, the human brain has layers of systems that arose for one purpose and then were adopted for others. The authors provide an overview of how human brains process sensory and cognitive information, regulate emotions, and form memories. By debunking myths about the brain—such as that

drinking kills brain cells and that classical music makes babies smarter—the authors say they hope to replace misinformation with the latest scientific findings. In addition to cocktail party topics, the authors offer well-researched advice on how to keep an aging brain sharp. **Bloomsbury, 2008, 220 p., b&w illus., hardcover, \$24.95.**

COLD LIGHT: Creatures, Discoveries, and Inventions That Glow

ANITA SITARSKI

Fireflies and fires have this in common: Light is emitted from electrons as they lose energy. Fires and light bulbs are left out as SitarSKI chronicles "cold light" for readers over age 9. The chemicals that react to create visible light from animals were elucidated in 1885 by the French scientist Raphael Dubois. He removed



and pulverized the parts of a fire beetle that emitted light. After mixing the resulting powder with a variety of solutions, he concluded he had two chemicals, which he subsequently named luciferin and luciferase (*lucifer* translates to "light bearer" in Latin). These chemicals have

since been found in other bioluminescent organisms, ranging from single-celled dinoflagellates to certain petite squids. While lantern fish use a luminescent lure to attract prey, scientists have learned to use cold light to help them with research. By inserting the genes from bioluminescent jellyfish into other cells, scientists can watch the fluorescent cells under a microscope and see where they move and proliferate within animals. **Boyd's Mills Press, 2007, 48 p., color photos, hardcover, \$16.95.**

BEYOND THE NANOWORLD: Quarks, Leptons, and Gauge Bosons

HANS GÜNTHER DOSCH

The physics of subatomic particles was the 20th century's quintessential big science. Discovering the building blocks of matter required smashing particles at ever higher energies, which in turn required accelerators and detectors of increasingly epic scales. Equally heroic efforts went into devising a



consistent theory of how those building blocks worked and interacted—what has come to be known as the standard model of particle physics. Dosch, a theoretical physicist at the University of Heidelberg in Germany, describes the field's historical unfolding, taking the reader deep into its concepts, experimental tools, and data diagrams. But Dosch's historical approach is a means to an end, and he keeps his focus on the science rather than on the lives of those who created it or on the political hurdles to securing support for billion-dollar experiments. **AK Peters, 2008, 282 p., b&w illus. and photos, hardcover, \$39.00.**

LETTERS

No cure yet

"Prozac makes new neurons mature faster" (*SN*: 2/9/08, p. 83) suggests that growth of new brain cells, along with increasing connections, may mediate some of the effect of some SSRIs. Since these new cells would likely persist significantly longer than the drugs themselves, do we see a "cure" after some period of time and, therefore, no need for continued administration of these drugs?

BOB COGLIANO, FORT WHITE, FLA.

The researchers suggest that, after people stop taking SSRIs (selective serotonin reuptake inhibitors), depression symptoms may return because constant application of the drug is necessary to induce growth and aid proper maturation of new neurons. Some people who take SSRIs can eventually stop taking the drugs without a return to depression. However, to be true cures, the drugs must correct the underlying cause. No one has yet shown that depression is caused by a defect in neuron growth and maturation. The defect may be a depression side effect. Growing new brain cells may alleviate symptoms, but it does not address the real cause. —TINA HESMAN SAEY

Formulating change

I've looked at the table for "FY '09 budget proposal ups physical sciences" (*SN*: 2/9/08, p. 86). No way do I understand where the percent changes come from. A change from \$80,192 million to \$80,494 million is listed as a 1.6 percent decrease. **DAVID ADAMS, GARNET VALLEY, PA.**

The numbers are adjusted for inflation, which will erode buying power by the time fiscal year 2009 begins. At the time we wrote the story, the Office of Management and Budget was predicting a 2 percent inflation rate. —SN STAFF

Correction "Galaxies may hail from early universe" (*SN*: 2/16/08, p. 100) was obscure about the brightness of one group of distant galaxies observed by a team that includes Richard Ellis and Johan Richard of the California Institute of Technology. The story implied that these galaxies appear faint because gravitational magnification of their light by foreground galaxy clusters was less than that for another distant galaxy, A1689-zD1, which is unusually (intrinsically) bright. In fact, the dimness is intrinsic, as the magnification was roughly the same for the faint group and A1689-zD1.

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