

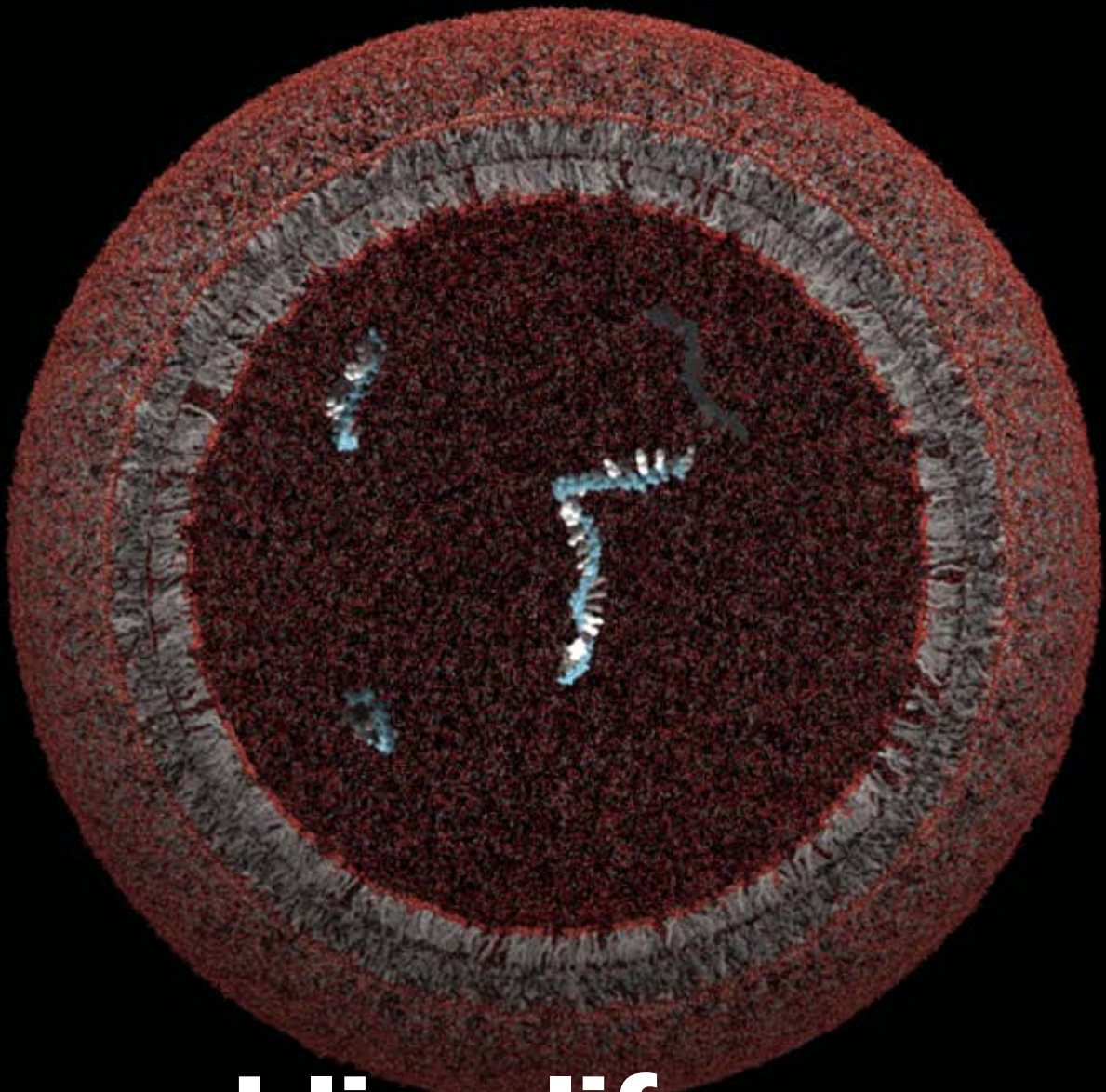
SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JANUARY 12, 2008 PAGES 17-32 VOL. 173, NO. 2

tar pit plethora in venezuela
more genetic clues to autism
glow identifies blue diamonds
blind fish, breed fish, see fish

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assembling life

RETRACING EVOLUTION'S PATH TO THE CELL

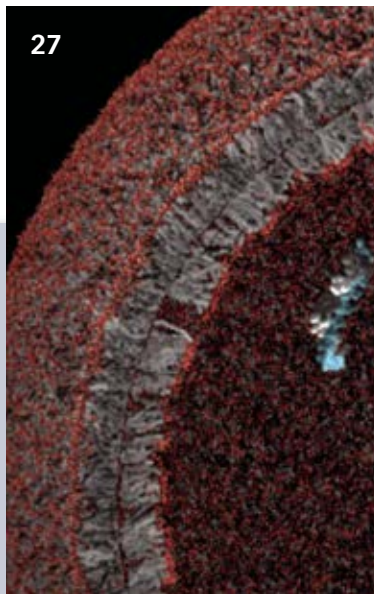
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Cover Combining a lipid membrane with self-replicating RNA-like molecules could be one way to create a living cell from nonliving molecules. Scientists may soon create such synthetic cells, and in the process learn valuable lessons about cell biology and the origin of life.
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Risky DNA

Autism studies yield fresh genetic leads

As scientists inch closer to unraveling autism's causes, this perplexing developmental condition increasingly shows its diverse roots. Consider two new genetic investigations.

One finds that spontaneous alterations to a tiny stretch of chromosome 16 contribute to about 1 percent of childhood autism cases. Either a deletion or a duplication of this DNA section raises a child's susceptibility to autism and related disorders, report geneticist Mark J. Daly of Massachusetts General Hospital in Boston and his colleagues.

The researchers plan to determine how tweaks to the DNA segment, which contains about 25 genes, promote autism. Their findings appear online and in an upcoming *New England Journal of Medicine*.

"This is one piece in the autism puzzle, but it's one of the few pieces that we have," Daly says.

The group of developmental disorders that includes autism affects as many as 1 in 150 children by age 3.

Daly's team used novel DNA-screening techniques to identify variations in the number of copies of each gene in the genomes of members of 751 families. Each family included two or more children diagnosed with autism or a related disorder, for a total of 1,441 affected youngsters.

Five individuals with autism displayed deletions of the key chromosome 16 segment. No such deletions appeared in their parents, leading the researchers to propose that these DNA alterations occurred during genetic recombination at or shortly after fertilization.

The researchers identified an additional five cases of the same DNA deletion among 512 children with autism or related disorders referred to Children's Hospital Boston. Four deletions had occurred spontaneously and one was inherited from a parent.

Finally, Daly's team detected the same chromosome 16 deletion in 3 of 299 residents of Iceland diagnosed with autism. Only 2 of 18,834 Icelanders without autism or a related ailment displayed the same deletion.

Moreover, seven individuals from the original sample and four youngsters from Children's Hospital, all with autism, possessed extra copies of genes within the crucial chromosome 16 area.

The second study indicates that inheriting one variant of a brain-related gene ups the chances that a child will develop autism. A team led by geneticist Aravinda Chakravarti of the Johns Hopkins University School of Medicine in Baltimore first identified DNA variations among 292 members of 72 families, including 145 children with autism. A small portion of chromosome 7 showed a link to the disorder.

A closer analysis indicated that children with autism tended to inherit a specific version of a gene within that area. Prior research

suggests that this gene makes a protein that fosters the growth of nerve projections essential for neural communication. Comparable findings emerged in a DNA analysis of 1,295 children with autism and their healthy parents, the researchers report online Jan. 10 in the *American Journal of Human Genetics*.

As genetic evidence mounts, new data question the con-

troversial contention that childhood vaccines have inflamed autism rates (*SN*: 9/29/07, p. 197). Autism's prevalence among California children continued to rise after vaccine manufacturers largely removed the mercury-containing preservative thimerosal from their products, according to a study directed by physician Robert Schechter of the California Department of Public Health in Richmond.

His analysis, published in the January *Archives of General Psychiatry*, covers children ages 3 to 12 receiving state services for autism between January 1995 and March 2007. Prevalence rates for the disorder increased gradually throughout that time for kids at each year of age. Manufacturers removed thimerosal from vaccines from 1999 to 2001. —BRUCE BOWER

Hued Afterglow

Fingerprinting diamonds via phosphorescence

The eerie phosphorescence displayed by a rare form of blue diamond can be used as an easy, cheap, and nondestructive way to identify individual gemstones and to dis-



BURNING BRIGHT Aspects of the phosphorescence of natural blue diamonds, such as the famed Hope Diamond (seen in visible light, top, and glowing in the dark after exposure to light, bottom) can serve as virtual fingerprints for the gemstones.

tinguish natural blue diamonds from synthetic ones, analyses suggest.

Phosphorescence, a "glow-in-the-dark" process in which energy previously absorbed by a substance is released slowly in the form of light, is common in a certain type of blue diamond. After exposure to light, these type IIb diamonds, which have boron- and nitrogen-containing impurities, softly glow in colors ranging from blue through pink to fiery red, says Sally Eaton-Magaña, a chemical engineer at the Gemological Institute of America in Carlsbad, Calif. The orange-red glow from the 45.52-carat Hope Diamond, a type IIb gemstone on display at the Smithsonian Institution in Washington, D.C., is visible for as long as a minute after the lights go out.

Although millions of visitors to the Smithsonian's National Museum of Natural History see the Hope Diamond each year, the gem has received remarkably little scientific attention. While a set of 239 colored diamonds known as the Aurora Heart Collection was on loan to the museum in 2005, Eaton-Magaña and her colleagues studied the set's type IIb diamonds as well as the Hope Diamond and the museum's 30.62-carat Blue Heart Diamond. They also studied the blue diamonds in the Aurora Butterfly Collection in New York City. In all, the researchers studied 67 natural blue diamonds, 3 synthetic ones,

QUOTE



This is one piece in the autism puzzle, but it's one of the few pieces that we have."

MARK J. DALY,
Massachusetts
General Hospital

and a gray diamond that other researchers had turned blue via treatments at high temperature and high pressure. In some of their tests, the scientists shone a high-intensity ultraviolet light on each gemstone for 20 seconds and then measured its phosphorescence at various wavelengths.

Reddish phosphorescence in diamonds was thought to be rare, says Eaton-Magaña. However, the tests showed that all natural type IIb diamonds glow for several seconds at two visible wavelengths—a 500-nanometer, greenish-blue light and a 660-nm reddish one. The relative strengths of the phosphorescence at the two wavelengths dictate the hue of a stone's overall glow. Differences in the peak intensities of those emissions and the rates at which they wane provide a virtual fingerprint for each stone, the researchers report in the January *Geology*.

Neither the synthetic stones nor the color-enhanced gray gemstone glowed at the 660-nm wavelength. The new technique's ability to distinguish between artificial diamonds and the true blue gems "solves one of the big problems in diamond markets," says Stephen E. Haggerty, a geologist at Florida International University in Miami.

Tests on the Hope Diamond suggest that variations in phosphorescence from one part of a large gem to another are negligible, says Eaton-Magaña. Scientists would therefore still be able to identify the pieces of a large diamond if it were stolen and cut into smaller stones. —SID PERKINS

Mind Control

Hypnosis offers amnesia clues

Hypnosis can make some people forget and, when given a special cue, quickly remember recently viewed scenes. A new study using the technique may shed light on the process of memory retrieval and the potential for one part of the brain to block it. Hypnosis-induced memory



TOTAL RECALL Subjects were asked to remember these documentary scenes—after they had received a hypnotic command to forget.

suppression may also expand understanding of amnesia.

Whenever the mind retrieves information, any number of memories might be conjured up by association. Yadin Dudai of the Weizmann Institute of Science in Rehovot, Israel, wondered how the brain selects only one memory and excludes many others.

Memory suppression is usually a healthy mental process that allows people to operate without the burdensome recollections of irrelevant or traumatic events. The process goes wrong in those with psychogenic amnesia, in which a person temporarily cannot recall certain life events.

Because amnesiac victims are difficult to study, Avi Mendelson, a graduate student in Dudai's laboratory, used hypnosis to induce memory suppression. He showed participants in the study, including a control group who were not susceptible to hypnosis, a documentary film. Recalling the content of the documentary taxes the same type of memory that records autobiographical episodes.

One week later, Mendelson attempted to hypnotize all the participants and gave them an instruction to forget the movie. Out of the hypnotic state, they answered yes-or-no questions about the movie while their brains were scanned. He then repeated the process, this time telling participants to remember the movie.

Clear differences turned up between the brain scans of participants susceptible to hypnosis and those who weren't, the researchers report this week in *Neuron*. In general, scans of nonsusceptible participants showed more activity in many brain regions during recall than scans of the susceptible group. But the brains of those under the hypnotic command did show more activity in a part of the prefrontal cortex.

"In normal memory retrieval there is a set of areas that are important," Dudai explains, "so we suggest that this area in the left rostrolateral prefrontal cortex is abating this process early on, halting activity that would occur downstream." In other words, the area denies access to memory-related regions until the hypnotic cue to remember flips its switch.

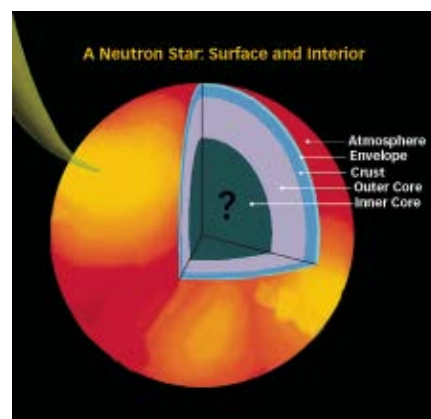
Some experts express skepticism for the poorly understood technique. Larry Squire, a neuroscientist at the University of California, San Diego, wonders about the supposedly suppressed memories of the hypnotized. "What if participants were told to try harder?" he says. "What if they were offered money to remember?" —AMY MAXMEN

Heavy Find

Weighty neutron stars may rule out exotic core

Neutron stars may be weird, but they're not so strange, a new study reveals.

Crushed by gravity, matter at the cores of neutron stars—the collapsed remains of heavyweight stars—is subject to a combination of enormously high pressure and low temperature that can't be attained in any laboratory. A thimbleful of the stuff weighs more than the entire human population, and physicists have few clues about how matter behaves under such conditions.



STELLAR ANATOMY Existence of superheavy neutron stars sets limits on composition of their inner cores.

For years, researchers have debated whether a neutron star core is composed predominantly of neutrons and a smattering of protons (and possibly a few other kinds of particles) or if it transforms into something much more exotic. Under gravity's pull, run-of-the-mill subatomic particles could conceivably turn into individual quarks, the fundamental building blocks of matter. The quark matter would consist not only of the up and down quarks that make up protons and neutrons, but also strange quarks, which aren't found in ordinary matter. Moreover, because quark matter is squishier than a mix of neutrons and protons, the stuff would collapse to form a black hole at a lower mass than a core of ordinary matter.

Astronomers studying several rapidly rotating neutron stars have now weighed in on the debate. Paulo C. Freire of Arecibo Observatory in Puerto Rico and his colleagues have found what appear to be two of the most massive neutron stars ever recorded. The stars are almost certainly too heavy to have quark cores, Freire reported in Austin, Texas, this week at a meeting of the American Astronomical Society.

He and his collaborators used the Arecibo radio telescope, as well as the Greenbank radio telescope in West Virginia, to study millisecond pulsars, radio wave-emitting

neutron stars that rotate hundreds of times a second and orbit a normal-density companion star. The team restricted its 18-year study to those pulsars that reside in Milky Way globular clusters—crowded concentrations of several hundred thousand stars. Because of their close interactions with neighboring stars, pulsars in globular clusters have elongated orbits, a shape that makes it much easier to infer the mass of these superdense stars.

According to Einstein's theory of general relativity, the direction along which the pulsar's orbit is elongated should slowly vary, or precess. (Mercury's precession about the sun was one of the first successful tests of general relativity.) Precession provides a measure of the total mass in a system.

Observations of the precession of the millisecond pulsar PSR B1516+02B, located some 25,000 light-years away in the globular cluster M5, indicate that the pulsar most likely has a mass equivalent to about 1.94 suns. Another pulsar, PSR J1748-2021B, which lies in the slightly more remote globular cluster NGC 6440, could have up to 2.74 times the mass of the sun, Freire says. In comparison, most quark-core models predict that a neutron star should be no heavier than about 1.6 suns. Additional mass would cause the squishy quark-core to collapse into a black hole.

Freire cautions that each measurement has a significant uncertainty, because precession directly reveals the total mass of a pulsar plus its companion star, rather than the mass of the pulsar alone. But in the case of PSR B1516+02B, chance observations with the Hubble Space Telescope indicate that the companion star must be tiny because it can't be seen, he notes. Previous measurements of two pulsars in the globular cluster Terzan 5, reported by Freire's team in 2005, also suggest that some neutron stars are heavier than quark models might allow.

The number of observations makes a compelling case for the existence of heavy neutron stars, comments Cole Miller of the University of Maryland in College Park. "We could be fooled in an individual case, but it would take malice from the universe to be fooled in all." —RON COWEN

Seeing Again

Blind fish parents have fry that see

Keep them in the dark for a million years. Then cross two strains of cave-dwelling fish, now totally blind. It turns out some of their kids will be able to see.

Fish and other creatures lose their sight after generations living in caves. Yet working vision genes from one parent can partly



LIGHT AND DARK A fish from generations of cave dwellers (front) ends up without eyes as an adult even though surface dwellers considered part of the same species complex (the two behind) develop normal eyes.

make up for defunct versions from the other parent, at least in young fish, reports Richard Borowsky of New York University.

The vision rescue experiment works only if mom and dad come from different caves, says Borowsky, illuminating how the blind cave strains evolved. Lineages of the same species, long separated in different caves may all end up blind, but different genes have mutated to converge on the same result, he concludes in the Jan. 8 *Current Biology*.

Other studies of the genetics of these fish have suggested this scenario of convergence, comments William Jeffery of the University of Maryland in College Park. "This really nails it down," he says.

Blindness in cave fish has intrigued evolutionary biologists as well as biomedical researchers studying the genes underlying eye development and sight. Dozens of species of blind fish live in caves around the world, but the Mexican cave tetra (*Astyanax mexicanus*) is "just a beautiful experimental animal," says Jeffery. Different forms will breed in the lab, including sighted forms that live in sunlit waters.

Borowsky mixed and matched strains from Mexico, where 29 caves shelter sightless varieties. He tested vision in the pure strains and hybrid crosses with a fish eye exam that works even for tiny fry.

To perform the test, researchers temporarily immobilize the fish in thick goo, which can be washed off. Then researchers move a circlet of alternating dark and light stripes around the fish and watch its eye motions. If the fish sees the stripes, its eyes twitch to track the stripe parade. When the researchers reverse the spin of the stripes, the fish's eyes twitch the opposite way.

Borowsky crossed blind fish from one cave, Molino, with those from Tinaja cave, about 100 kilometers away. When the offspring were just over a week old, 39 percent of them passed his eye test.

When he crossed the Tinaja strain with fish from nearby Curva cave, though, none of the offspring could see. The fish from the neighboring caves probably shared too much history to have genes that could rescue each other, he says.

The cave hybrids typically lost their sight as they grew up. But when Borowsky crossed cave dwellers with surface fish, some of the offspring did retain vision into adulthood.

In a set of multigenerational crosses, Borowsky saw vision-inheritance patterns that confirm there's little overlap between the genes that mutated in the far-flung cave systems. Evolution uses "a large and varied palette," he says.

"This can be generalized," says Horst Wilkens of the University of Hamburg in Germany. He predicts that plenty of cave species will turn out to have evolved their typical pale, blind form through a variety of genetic losses. —SUSAN MILIUS

Positive Signal

Lone protons carry messages between cells

Roundworms need protons to poop.

New research shows that protons released by roundworms' intestines trigger surrounding muscles to contract, causing the worm to defecate. The discovery marks

the first time that scientists have found protons transmitting signals between cells.

The research also adds new support to the idea that protons might relay electrical signals in the human brain.

“A proton acting as a transmitter between cells was pretty unexpected,” says Erik Jorgensen, lead scientist on the study at the University of Utah in Salt Lake City. “This is a fundamental subatomic particle, so it was a little hard to imagine it performing that role.”

Normally, signals between cells are carried by multi-atom molecules with specific shapes that fit into corresponding receptor molecules. A proton is what’s left when a hydrogen atom is stripped of its electron; it’s about 1/100,000th the size of the original atom.

In spite of their tiny size and lack of a characteristic shape, protons already were known to activate receptors on the surfaces of some nerve cells. These receptors, called acid-sensing ion channels (ASICs), allow pain nerves to sense the ambient concentration of protons—in other words, the pH. That’s why touching strong acid burns.

Jorgensen’s team found an ASIC-like receptor on the muscle cells surrounding the gut of the roundworm *Caenorhabditis elegans*. Previous studies by other researchers had shown that the worms’ intestines pump protons into the space next to the muscles, and Jorgensen and his colleagues wondered whether these protons could be causing muscle contraction by binding to the receptors.

Blocking the new receptor in one experiment caused the worms to become constipated, the team reports in the Jan. 11 *Cell*. In another experiment with working receptors, manually adding protons into the space adjacent to the muscles caused them to contract.

The study “supports the idea that protons can function in intercellular signaling, which is exciting,” comments John A. Wemmie of the University of Iowa in Iowa City.

Wemmie and his colleagues previously showed that removing proton receptors in the brains of mice impaired the animals’ learning and memory. Human brains also have proton-sensing ASIC receptors as well as proton pumps, so Jorgensen and others suspect that protons might carry signals between nerve cells in mammalian brains.

If so, protons would join the short list of fast-acting neurotransmitters, which work by opening pores in the surfaces of nerves and letting electrically charged particles flow through, resulting in an electrical impulse. Slow-acting neurotransmitters, which are more numerous, cause a metabolic change in the recipient nerves instead of an electrical one.

“Those fast neurotransmitters are an elite group,” Jorgensen says. “There’s not a lot of them.” —PATRICK BARRY

Bathtub Optics

Bending light also shifts it sideways

The familiar optical illusion that makes a pencil look broken when half-dipped in water just took a new twist. A new experiment shows that when light bends at an interface (such as between water and air), the light’s photons take a sideways shift depending on their polarization—something scientists didn’t even suspect until a few years ago.

Physicists call the broken-pencil effect refraction. It’s how lenses redirect light. When crossing at an oblique angle from air into glass or water, or between any two different transparent materials, light’s path bends.

In 2004, physicists in Japan first suggested that another, subtler effect may

occur. Light consists of electromagnetic waves that vibrate sideways with respect to the light’s path. In linearly polarized light, the sideways vibration is all in the same direction, while in circularly polarized light, it spirals around the trajectory in a corkscrew fashion. The Japanese physicists calculated that when a photon crosses an interface, its circular polarization, or spin, will affect its trajectory by a tiny amount depending on whether the spin is clockwise or counterclockwise. “In addition to the bending, it shifts sideways,” says Onur Hosten of the University of Illinois at Urbana-Champaign.

Physicists called this the spin Hall effect of light, in analogy with a just-discovered “spin Hall effect” that affects electrons of different spins moving inside a semiconductor.

Unfortunately, trying this at home in your bathtub won’t work: The shift in a pencil’s image would probably be smaller than the size of the light receptors in your retinas.

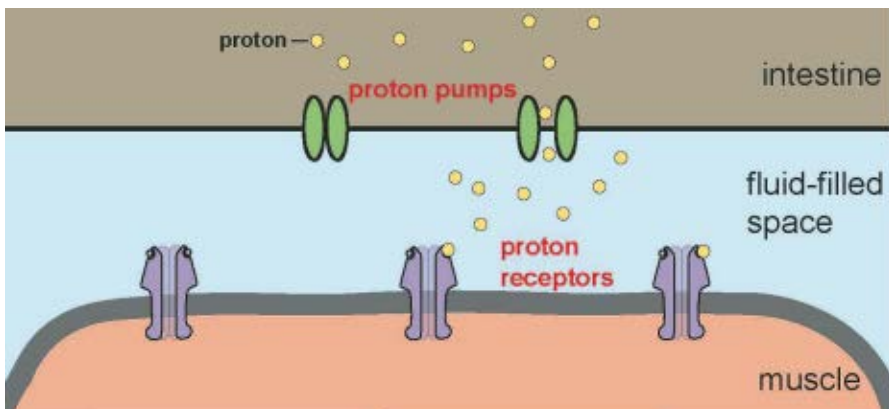
To test the Japanese team’s prediction, Hosten and his Illinois colleague Paul Kwiat focused a laser beam onto a glass prism at different angles. As the millimeter-wide beam bent on passing into the glass, they expected photons of opposite spins within the beam to get kicked sideways in opposite directions. But the shift would be measured in nanometers, so the resulting two parallel beams would still mostly overlap. To detect such a tiny separation, Hosten and Kwiat had to devise a new trick.

Their beam’s initial polarization was linear and horizontal, equivalent to equal numbers of photons with opposite circular polarizations. In the vertical plane, the two rotating fields perfectly canceled each other out, while reinforcing each other in the horizontal plane.

But by separating the two components, the spin Hall effect would spoil this symmetry and introduce a small vertical polarization, the team expected. The researchers filtered out almost all the horizontally polarized photons emerging from the prism and combined the remaining photons to effectively amplify the spin Hall effect 10,000 times. That enabled the physicists to detect shifts of up to 60 nm with a precision of 0.1 nm, they report this week in the online edition of *Science*.

Aephraim Steinberg of the University of Toronto in Canada says that the team devised a “novel approach” that might become useful for other kinds of measurements, though he adds that the spin Hall effect itself is unlikely to find applications anytime soon.

Kwiat, however, says that the spin Hall effect could help physicists test the microscopic components of future computers that use photons instead of electronic circuits. —DAVIDE CASTELVECCHI



MINIMESSENGER Protons diffuse quickly from a roundworm’s gut and bind to receptors on surrounding muscles. The receptors then cause the muscles to contract, which makes the animal defecate.

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LA BREA DEL SUR

The fossil-rich tar pits of Venezuela may rival those of Southern California

BY SID PERKINS

Los Angeles' Rancho La Brea is one of the world's most famous fossil-bearing sites. The tar pits there have yielded more than 1 million fossils representing 50 mammal species, 125 types of birds, and dozens of reptiles, insects, and other invertebrates. But L.A.'s claim to fossil fame could someday soon be equaled or surpassed by any of several spots far south of the U.S. border.

Thousands of miles from Rancho La Brea, hundreds of similar petroleum seeps, or *menes*, dot the landscape in Venezuela. Although explorers have known of these animal-trapping sites since the 16th century, only in the past decade or so have paleontologists begun to conduct serious digs. So far workers have removed less than two truckloads of sediment at the most thoroughly studied site, yet the number and diversity of fossils found already suggest that the South American pits may eventually rival Rancho La Brea.

For one thing, the Venezuelan *menes* are found in a variety of ecosystems, so their sediments may hold a wider variety of creatures. Also, because these sites are located near where the Isthmus of Panama joins South America, their fossils may shed light on the migrations of creatures to and from the continent. Finally, excavations at one site suggest that its oil-rich sediments—and the creatures that they've trapped—have accumulated over a much longer period of time than those at Rancho La Brea. Thus fossils entombed there might yield insights into how and when climate changed as Earth slipped in and out of recent ice ages.

STICKING POINTS At thousands of sites in southern California, crude oil seeps up from petroleum-rich strata to Earth's surface through cracks in the overlying layers of rock. The more-volatile components of that sludge quickly evaporate, leaving behind asphalt-rich goo that can mire even the strongest creature. Yet only a handful of such places in the region—Rancho La Brea, two other sites near the Pacific coast, and two more farther inland—have yielded substantial numbers of fossils.

The same sort of stratigraphy can be found in northern South America, says David M. Orchard, a geologist with ConocoPhillips in Houston. Tar pits occur in a swath from Trinidad, a Caribbean island off the northeastern coast of Venezuela, westward to Peru

and Ecuador, he notes. In the oil-rich Maracaibo Basin of northwestern Venezuela alone, a small area about one-tenth the size of California, there are more than 200 *menes*. There, crude oil from the La Luna formation—an organic-rich shale whose sediments were laid down about 75 million years ago—seeps to the surface through overlying sediments as much as 6 kilometers thick. Orchard and Ascanio D. Rincón, a paleontologist at the Venezuelan Institute of Scientific Investigations in Caracas, described the geological context of the *menes* in October in Austin, Texas, at a meeting of the Society of Vertebrate Paleontology.

So far only a few South American tar pits have been studied in depth or yielded fossils, says Orchard. For example, Peru's Talara site or Ecuador's La Carolina site, both of which were studied by Canadian researchers in the 1950s, proved exceptionally rich in the remains of birds and canids, a group of mammals that includes dogs, wolves, and foxes. The subsequent dearth of attention paid to South America's *menes* is coming to an end, however. In particular, paleontologists are clamoring about fossils found in a tar pit near Inciarte, in northwestern Venezuela.

That *mene*, more than 1 km long and 500 meters wide, is at least 10 times the size of the tar pits at Rancho La Brea, says Orchard. Nevertheless, paleontologists have removed only about 1.5 cubic meters of sediment, or around 15 wheelbarrow loads, from the site. That

fieldwork—which involved carefully digging down into the oily muck 10 centimeters at a time, screening the material, and then tallying the fossils—took place in the summer of 1998.

In that single field season at the Inciarte site, researchers dug no deeper than 1 m into the *mene*, says Rincón. Despite that limited excavation, he and his colleagues identified the remains of more than 100 species, including 43 mammals, 56 birds, 11 lizards, and 4 frogs. One of the mammal species, a type of bamboo rat related to species that live in the Amazon Basin today, represents a new genus.

As at Rancho La Brea, most of the vertebrate fossils from Inciarte show up as disarticulated bones. Even so, the tar can preserve fragile fossils like those of beetles, snails, and the delicate bones of bats. Of the million or so bones found at Rancho La Brea, only four come from bats, says Nicholas J. Czaplewski, a paleontologist at the Oklahoma Museum of Natural History in Norman. However, he notes, a dozen or so of the fossils from Inciarte—including skulls, jaws, teeth, and a humerus—belonged to bats.

The Inciarte bats may have fallen victim to the *mene* when they



BUBBLIN' CRUDE — Green dots on this map of western Venezuela depict the locations of petroleum seeps, or *menes*. One fossil-bearing tar pit lies near Inciarte in the far western part of the country.

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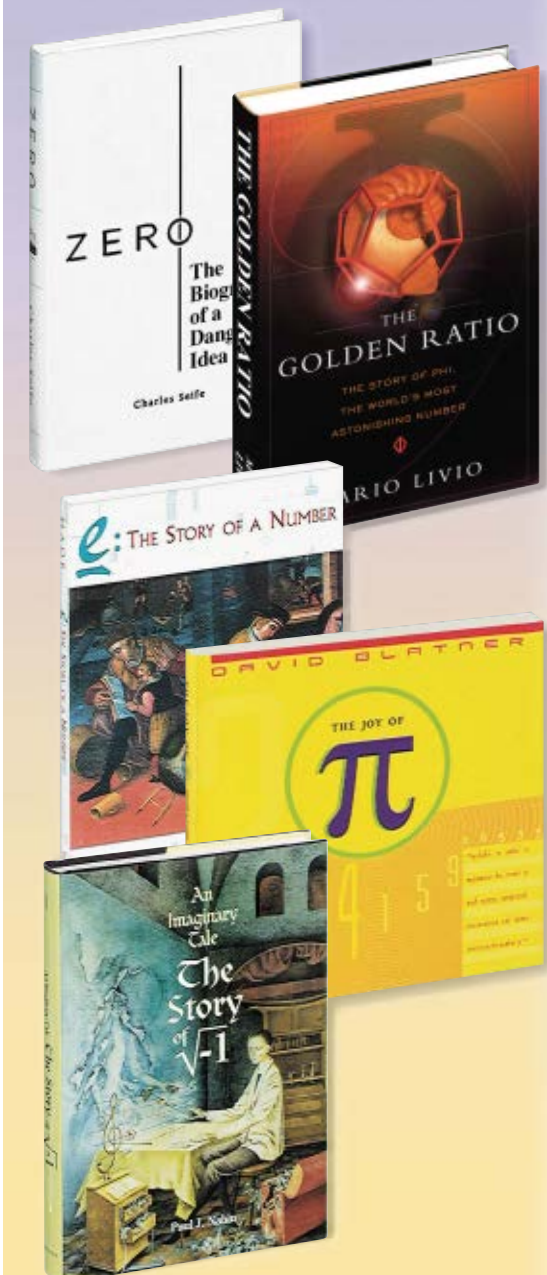
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tried to snap up an insect floating on a thin veneer of water that masked its tar, says Czaplewski. Or, he suggests, the flying creatures may have been snagged by the underlying tar while taking a drink as they skimmed the surface of the water—another common behavior among modern bats. The presence of a shallow pond atop the tar during some seasons also may explain why many of the birds found in the *mene* represent aquatic species, says Orchard.

Along with the fragile fossils of bats and insects, Venezuelan *menes* have yielded the tar-soaked remnants of plants, says Gregory McDonald, a paleontologist with the National Park Service in Fort Collins, Colo. Such fossils usually aren't preserved in sediments in warm environments and could help scientists track long-term changes in the area's climate. "Who expects wood to be preserved in the tropics?" he asks. "It typically gets recycled when it rots."

Rincón and his colleagues have carbon-dated some of the Inciarte fossils, which range between 25,000 and 27,000 years of age—a few millennia before the height of the last ice age. Because researchers don't know the depth of the tar in the *mene* there, it's not yet possible to predict whether older fossils may be found.

GONE TO THE DOGS The species tally at Inciarte renders that site the most fossiliferous in northern South America. In general, says Rincón, tar pits can yield the remains of species that aren't commonly preserved in other types of rocks. Therefore, *menes* probably offer a more thorough chronicle of the creatures that lived or foraged nearby than do other types of sediments. Compare, for instance, the 43 species of mammals found at the Inciarte *mene* with the 24 excavated from the tarfree sediments at Taima-taima, an archaeological site along the eastern coast of Venezuela. At that location, most of the fossils represent species eaten by humans who had lived or hunted there.

The Inciarte excavations have produced several revelations about the region's ancient canids. Researchers have identified fragments of the skull of *Urocyon cinereoargenteus*, the gray fox, for example. Fossils of that species have never before been reported from South America, says Rincón.

Also, teeth and jaw fragments of *Procyon troglodytes*, an extinct species known as the cave wolf, have turned up at Inciarte. This creature is known only from South America and previously has been found only at sites at least 1,500 km away and toward the south, says Rincón. He and colleague Francisco J. Prevosti, a paleontologist at the La Plata Museum in Buenos Aires, reported their finds in the September *Journal of Paleontology*.

The presence of *P. troglodytes* at Inciarte raises the possibility that members of the species could have migrated north into Central America during the last ice age, says Rincón. So far, paleontologists have no evidence that ancient Panama had the open grasslands and forest-edge environments that this creature apparently preferred. However, he notes, such ecosystems could have existed along the isthmus' ancient coastlines, which later became flooded when sea levels rose.

"At Inciarte, there's a commingling of what are typically thought of as North American and South American species," says Christopher A. Shaw, a vertebrate paleontologist at the Natural History Museum of Los Angeles County. There, the ground sloths, camels, and other species characteristic of ancient South

America lived alongside the dire wolves and saber-toothed cats typically associated with Rancho La Brea and other North American sites. "It's a good spot to look at the interchange," Shaw notes.

Rincón agrees: "We know a lot about the species in North America and in Argentina. In the middle, we know almost nothing about what happened."

RICHES OF THE ORIENT Like western Venezuela's Maracaibo Basin, the Maturín Basin in the eastern part of the country is dotted with scores of *menes*. In 2006, workers digging a pipeline there unexpectedly began to excavate oil-rich sediments that were chock-full of bones. Work at the site quickly ceased, and researchers were called in to conduct what Orchard of ConocoPhillips describes as "salvage paleontology" before the walls of the waist-deep trench collapsed. Although the fieldwork at the site, dubbed El Breal de

Orocual, was rushed and wasn't as systematic as it could have been, early results are promising.

Paleontologists have so far identified the fossils of more than two dozen species, says Rincón. The presence of semiaquatic creatures such as caimans and tapirs suggests that the area once was a floodplain or river delta, he notes. However, the remains of creatures such as llamas and glyptodonts—armored armadillos, some species of which grew to the size and weight of Volkswagen Beetles—hint that the area also hosted a savannah. Probably, says Rincón, the *mene* sat in a swampy area where water helped disguise the deadly tar.

As at Rancho La Brea, predators at Orocual dramatically outnumber the prey. Most of the herbivores trapped in the *mene*,

such as tapirs, camels, horses, and the like, were young animals—inexperienced creatures much more likely than adults to be trapped in the tar. However, most of the predator fossils, such as those of wolves and saber-toothed cats, came from adults, who probably attempted to partake in an easy feast before they themselves became entrapped. Analyses of the Orocual sediments suggest that they were deposited between 1 million and 500,000 years ago, Rincón reported in October at the vertebrate paleontology meeting.

Orocual "is the first area I've seen that can rival Rancho La Brea," says Shaw. "The preservation is just wonderful down there, and it's amazing how well even delicate things like centipedes have been preserved." The diversity of fossils, including plants and invertebrates, is "incredible," he adds. "The fossil record there is as rich as, if not richer than, Rancho La Brea." Considering the extent of the site, Shaw speculates that it could easily yield hundreds of thousands of fossils.

Although each tar pit may be active for only a few thousand years, just a small sampling of the vast number of *menes* in Venezuela could provide paleontologists with a fossil record for the region that could extend back more than 2 million years, to an era before Earth began its regular cycle of ice age and interglacial periods. In contrast, notes Orchard, the fossil record at Southern California's Rancho La Brea stretches back only 40,000 years or so.

"The combination of that age range and the diversity of ecosystems that could be represented in these *menes*," Orchard says, "is an extraordinary opportunity for science."

"The Inciarte site is so rich, there's more [paleontology] than anyone can do in a lifetime," says McDonald. "We're just now beginning a very long and very exciting process." ■



DEATH TAR — The *menes* of Venezuela have claimed many lives, evident in this 25,000-year-old fossil found near Inciarte and the more recent remains of a songbird at Orocual (inset).

LIFE FROM SCRATCH

Learning to make synthetic cells

BY PATRICK BARRY

Maggots don't arise spontaneously out of dead, rotting meat. Aphids never materialize within drops of morning dew. Aristotle and others who believed in the spontaneous generation of life were dead wrong.

The only time life arose from nonlife, biologists believe, was almost 4 billion years ago, when simple living cells first appeared on Earth. But now, with the help of a microscopic parasite that infects people's genitals, researchers may rehabilitate the core of Aristotle's idea.

Scientists are on the verge of creating living cells by piecing together small molecules that are themselves not alive. The result would be the world's first human-made life forms, synthetic cells made more or less from scratch.

The goal is to make cells that are as simple as possible, yet still able to grow, reproduce, and evolve—some of the defining traits of life.

"Simplicity has always been where we try to gain understanding," says John Glass of the J. Craig Venter Institute in Rockville, Md. "In a way, what we're doing is making a better platform for understanding what life is." It's a bit like learning the essentials of how a luxury car works by building a dune buggy from spare parts.

Some scientists, including Glass, hope to make such a minimal cell by whittling down the genome of an existing bacterium to its barest elements, and then synthesizing that minimal genome. In the lab, scientists can assemble the genomic DNA by piecing together chemicals called nucleotides, which constitute the individual letters of genetic code.

Other scientists, starting from long lists of molecules and genes, are devising plans to assemble these parts to make an entire cell, not just its genome, by hand.

Still other researchers take a radically different approach. Instead of trying to construct cells from the same proteins and DNA found in modern organisms, these investigators hope to assemble a cell from more-primitive molecules that better mimic the molecules probably involved in the origin of life. If successful, these scientists may uncover clues about how the original "spontaneous generation" of life occurred billions of years ago.

The first step, however, involves that irritating parasite.

STARTING SMALL Being a parasite has its perks. Living inside a mammalian host, a microbe enjoys a constant, comfy temperature and an endless supply of nutrients.

Because their living conditions are relatively cozy, parasitic microbes can get by with much smaller genetic toolkits. That's why one of the smallest known bacterial genomes belongs to *Mycoplasma genitalium*, a parasite that can infect the cervix and vagina of women and the urinary tracts of women and men.

While the human genome contains more than 3 billion letters of DNA code, *M. genitalium* has only about 580,000. This tiny genome encodes a mere 528 genes.

Even that's too many for Hamilton Smith, a Nobel laureate and Glass' colleague at the Venter Institute.

For the past 9 years, Smith's team has been systematically removing single genes from *M. genitalium* to see which ones the bacterium can survive without. So far, the group has found about 100 genes that are dispensable when removed individually. Many of these genes help the microbe evade the human immune system, which isn't necessary in lab dishes.

However, "it's unlikely that all of the 100 could be removed simultaneously," Smith said last June at the Synthetic Biology 3.0 conference in Zurich. Some genes perform redundant functions, so if Smith's team removes one of these, the microbe can keep chugging along. But if the researchers take out all of the genes responsible for a crucial task, the organism will die.

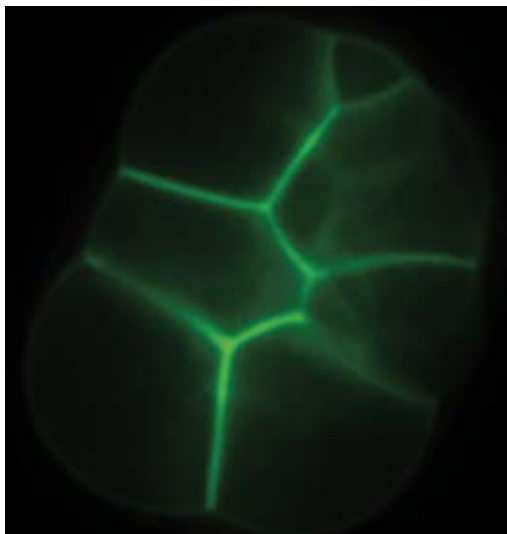
With so many genes that might be expendable, testing every possible combination by hand would take years. So instead, the scientists produce thousands of combinations quickly and grow them in lab dishes to see which ones survive. "You let biological selection tell you

what's necessary," Glass says.

Using this method, the team is homing in on a set of essential genes. With this minimal genome in hand, the researchers plan to build the DNA synthetically by stringing together individual nucleotides in the right sequence. Assembly of made-to-order DNA has become routine, but nobody has ever put together a single DNA molecule that's hundreds of thousands of nucleotides long.

To synthesize an entire minimal genome, Smith and his colleagues are stitching together medium-length segments of DNA using enzymes to join matching, overlapping regions capping the ends of each fragment. This way, the team can assemble the genome piecemeal rather than trying to synthesize it all at once.

"We eventually want to make an organism called *Mycoplasma*



BABY STEPS — Each of the liposomes in this cluster contains all of the molecular machinery for synthesizing proteins, along with the gene for a green fluorescent protein. The green glow shows that protein creation is happening within the fatty membranes, a step toward making living synthetic cells.

laboratorium,” Smith says. The more familiar name for this hypothetical cell is Synthia.

Glass says that the team is on the verge of making such a cell within the next few months. In the Aug. 3, 2007 *Science*, the researchers announced that they had transplanted the entire genome of one species of *Mycoplasma* into a related species. The recipient cells began using the foreign genome as if it was their own, showing that the receiving cells can “boot up” the newly inserted DNA (*SN*: 6/30/07, p. 403). All that remains is to finish piecing together a minimal, synthetic genome and then to insert it into a *Mycoplasma* bacterium by the same technique.

Beyond serving as a hobby-kit cell for unraveling basic cell biology, Synthia might serve as a platform for developing novel biotechnologies.

“Learning how to rebuild something will give us control over a cell that we don’t now have,” Glass says. Craig Venter, the scientist-cum-biotech tycoon who led the private effort to map the human genome and now heads the Venter Institute, has said he hopes that a minimal genome will serve as a base upon which to add custom functions, such as genes for converting feedstock into hydrogen for fuel.

“Ultimately I’m not going to want a cell that’s capable of a great many things,” Glass says. “I’m going to want a cell that can do one thing for me.”

This narrowness of function could help address possible safety concerns. “*Mycoplasmas* are extremely wimpy organisms, and minimal organisms will be even more limited,” Glass says. Because of their barebones genetic toolkits, such microbes would only survive under carefully controlled laboratory conditions.

ASSEMBLY REQUIRED Synthia would be an important scientific milestone, but it would still be only partially synthetic.

The genome would be human-made, but the membrane enclosing the cell and the complex blend of proteins in the cell body would have come from the living bacterium that received the injected genome.

“Essentially, we are commandeering the shell of a [preexisting] cell,” Glass says.

Another shortcoming of the Venter Institute’s approach, in some scientists’ view, is that the team would have created a semisynthetic cell without fully understanding their creation.

“Even in *Mycoplasma*, the functions of a fifth of the genes are unknown,” says Tony Forster of Vanderbilt University in Nashville. “So, the concept of using that as a minimal organism is still fraught with an enormous number of unknowns, which doesn’t really give you much understanding of what’s going on.”

Forster is one of several scientists pursuing a more comprehensive approach that could be years, instead of months, away from completion. The idea is to piece together all of the cell’s essential systems using small molecules to produce something that’s alive—if just barely.

“I realized that I had most of the parts I needed in the [laboratory] freezer, so it’s time to start thinking about putting together the whole thing,” Forster says. In theory, this bottom-up approach would allow scientists to understand all of the parts of the cells that they make.

Working with George Church of Harvard University, Forster published a detailed recipe for how to make a living cell from

scratch in the August 2006 *Molecular Systems Biology*. Their plan calls for a synthetic genome containing 151 genes that produce all the basic molecular machinery for protein creation and DNA replication.

Wrapping this manmade genome in a spherical shell of lipid molecules—along with some chemically synthesized protein-production molecules to get protein biosynthesis started—should in theory yield a living, growing cell.

It may sound farfetched, but scientists have already taken some significant steps. Making a lipid bubble to serve as a membrane is

fairly easy. Just as water beads up on a waxy surface, fat molecules in water will spontaneously cluster into thin spheres called liposomes. In fact, real cell membranes also consist of a kind of lipid. Scientists have long thought that this suggests that the first cells may have evolved from protocells formed by this natural beading up of fat molecules.

In 2004, Albert J. Libchaber of the Rockefeller University in New York City created liposomes and added the gene for a green fluorescent protein as well as all the molecular machinery needed to convert the genetic code into proteins. The result: green, glowing fat bubbles.

It was a deceptively simple demonstration. Protein synthesis is extremely complicated, and it’s crucial for living cells because proteins do most of the work that keeps cells alive. However, Libchaber’s team used an extract from the bacterium *E. coli* to provide the protein-making system, essentially borrowing the entire system from a living organism without knowing fully what it consisted of or how it worked.

More recently, Giovanni Murtas of the Enrico Fermi Research Centre in Rome succeeded in making green-glowing liposomes by instead using a cocktail of 36 enzymes and other molecules that had been synthesized by a team of scientists led by Hiroshi Ueda at University of Tokyo in Japan. The researchers reported the results in the Nov. 9 *Biochemical and Biophysical Research Communications*.

Of course, protein-making fat bubbles still fall far short of a growing, reproducing, living cell. Before that landmark can be reached, several challenges must be met.

Most significant, perhaps, is the difficulty of making ribosomes. While many enzymes are involved in protein synthesis, ribosomes are the cell’s main protein factories. Each ribosome is a complex assembly of proteins and RNA molecules, which are similar to DNA but with only one strand instead of a double helix. Scientists have made bacterial ribosomes in the lab, but only at temperatures too high for liposomes to endure.

Presumably, since natural cells can make ribosomes, scientists could simply replicate those cells’ natural machinery in their synthetic liposomes, and ribosomes would spring forth. But ribosome creation requires many RNA-modification enzymes that are still unknown.

IN THE BEGINNING Conjuring simple life from nonlife in a dish would no doubt raise comparisons with the emergence of the first living cells on Earth about 4 billion years ago.

“The closer we get to a simple system, the closer we get to a good early cell model,” Murtas said at Synthetic Biology 3.0.

But the analogy is not perfect. As Murtas points out, “Using [modern] biological molecules, I find it hard to believe that an early simple cell ... can ever have existed with only 30 to 40 genes.”



COPY THIS? — Coaxing synthetic cells into building ribosomes, the complex structures that convert genetic code into functional proteins, is a major challenge for those attempting to create cells in the lab.

But how could it be possible for the first cells to have already evolved more than 40 working genes?

The synthetic minimal cell envisioned by Forster and Church wouldn't reveal much about how life began. For one thing, the protein and gene "parts" from which scientists would build such a cell are all modern molecules shaped by millions or billions of years of evolution. Assembling these parts into a simpler system would be like building a Model T using Honda parts: It wouldn't turn back the hands of time on the parts themselves.

More fundamentally, though, the earliest living cells on Earth didn't have DNA or proteins at all, most scientists think. Instead, those cells most likely relied on simpler RNA molecules to act as both catalysts for chemical reactions (as proteins do) and carriers of genetic information (like DNA) (*SN*: 4/7/01, p. 212).

"We're all pretty confident that there was an early phase in the origin of life in which cell functions were carried out by RNA," says Jack Szostak of Harvard Medical School in Boston. The inner workings of such a cell would be radically different from those of any cell made using modern parts.

Szostak and others are pursuing a third way to create a human-made cell that would more closely resemble the origin of life. In its idealized form, such a cell would consist of a simple lipid membrane housing a single type of RNA-like molecule that is capable of self-replication.

The actual design might end up being just that simple.

Research published by Szostak and his colleagues in 2004 showed that an internal pressure on the membrane caused by a growing number of RNA molecules is enough to cause the membrane to take up lipid molecules from the environment and enlarge.

"You can do this with just physical principles," Szostak says.

The challenge, then, is to design an RNA or similar molecule that can self-replicate efficiently. Trying to do so has already yielded some lessons about the origin of life.

The earliest self-replicating molecules needed to overcome a few

hurdles that also vex researchers. RNA degrades relatively quickly, so forming RNAs that are long enough to carry much genetic information is difficult. And during self-replication, a newly formed RNA strand becomes bound to the original strand like the two sides of a zipper. Scientists are still searching for efficient ways to pull off the new strand so that the original template can repeat the process.

Because of these difficulties, Szostak and others are experimenting with a variety of novel RNA-like molecules. Rather than testing every possible variant by hand, scientists such as Gerald F. Joyce of the Scripps Research Institute in La Jolla,

"Learning how to rebuild [a cell] will give us control...we don't have now."

— JOHN GLASS,
J. CRAIG VENTER
INSTITUTE

Calif., set up experimental conditions that guide the rapid evolution of these molecules toward the desired traits. "You select for molecules that do what you want, then you amplify the ones that do that, then you repeat the cycle," Szostak explains.

This technique has already produced RNA-like molecules that can reproduce, but the process is still inefficient and error prone. It's hard to predict how long it will take for scientists to stumble upon a viable candidate, but Szostak thinks it may not be far off. "The magnitude of the improvement that's needed is not huge," he says.

If they succeed, scientists might be able to observe how this primitive cell evolves more-complex traits over time, like watching a reenactment of the origin of life.

For all three of these approaches to making synthetic or semi-synthetic cells, it seems to be a question not of if, but when. Once people learn how to make living cells from scratch in the lab, perhaps life there will routinely emerge out of nonlife, though not quite in the way that Aristotle imagined. ■

OF NOTE

EPIDEMIOLOGY

Smoking ups risk for type 2 diabetes

It's well known that smoking causes heart disease and several types of cancer. Researchers now say that the habit also boosts the risk of developing type 2 diabetes, by as much as 61 percent.

That's for people who smoke at least a pack a day. Lighter smokers face a 29 percent increased risk for diabetes, compared with people who never smoke, while former smokers have a 23 percent increased risk, according to an analysis in the Dec. 12 *Journal of the American Medical Association*.

The authors reached their conclusions after reviewing 25 studies that included

1.2 million people. Carole Willi of the University of Lausanne in Switzerland led the research.

While the types of observational studies included in the report cannot conclusively prove that smoking causes diabetes, the authors say that there is strong evidence that it does. First, smoking always preceded diabetes in the studies. Second, more smoking led to a higher risk. And third, other research has found plausible biological reasons for the connection: Smoking causes insulin resistance and damages insulin-producing beta cells in the pancreas, a two-pronged diabetic impact. —BRIAN VASTAG

ZOOLOGY

Purring birds teach their chicks to beg

African birds called pied babbblers turn out to have their own version of goofy baby-feeding noises—think "Mmm nummy nummy aaaapricots." What's more, the

birds actually teach their chicks that the sounds mean food, says Nichola Raihani of the University of Cambridge in England.

To test whether the babbblers were actively teaching, Raihani and collaborator Amanda Ridley of the University of Cape Town in South Africa examined whether the bird parent modified its behavior around the chicks in a way that promoted learning but inconvenienced or offered no benefit to the adult.

The researchers watched clusters of the *Turdoides bicolor* babbblers, medium-sized black-and-white birds, cooperating to raise chicks. Adults feeding the chicks often fluttered their wings and made a purring sound heard only when chicks were present. The researchers found no benefit of the behavior to the adult. In fact, the babbblers that purred and fluttered a lot were the most likely to lose weight by the time chicks fledged.

To study effects on the chicks, the researchers broadcast extra purrs during mealtimes near some of the very young broods, when adults were just starting the behavior sporadically. For other broods, the researchers broadcast purrs when no food

was in sight. After 2 days, the chicks in the mealtime-broadcast nests were ahead of their age-group in readily begging at the sound of a purr. The wrong-time-broadcast chicks had little to no response.

The youngsters are learning, Raihani and Ridley conclude in the January *Animal Behaviour*. —SUSAN MILIUS

PALEOBIOLOGY

The warm jungles of ancient France

Chemical analyses of amber excavated near Paris suggest that France was covered with a dense tropical forest about 55 million years ago.

Amber is a form of fossilized tree sap. Paleontologists discovered copious deposits of the material in the sediments of the Oise River basin, about 50 kilometers north of Paris, in 1997. Fossils in those strata, which were laid down between 55 million and 53 million years ago, are diverse and exceptionally preserved, says Akino Jossang, a biochemist at the National Museum of Natural History in Paris. More than 300 species of arthropods have been found entombed in the Oise amber.

Jossang and her colleagues measured how samples of the Oise amber absorbed various wavelengths of infrared radiation. Results did not match those for Baltic amber, so the researchers used dichloromethane to extract organic compounds from French amber samples. One of those chemicals—named quesnoin—isn't found in other amber, the team reports online and in the Jan. 18 *Journal of Organic Chemistry*.

One precursor of quesnoin, a substance called isoozic acid, is produced in small quantities by several types of plants but in abundance by *Hymenaea oblongifolia*, a tropical tree that lives only in the Amazon rainforest. Other ancient *Hymenaea* species are suspected to have produced Dominican amber (*SN*: 3/30/02, p. 202).

The presence of a presumably tropical plant species in France 55 million years ago, when the region was located at a latitude equal to that of modern-day New Orleans, hints that Earth's climate was much warmer then than it is now. —SID PERKINS

BEHAVIOR

Foster care benefits abandoned kids

A study in Romania finds that children abandoned at birth and placed in state-run institutions display marked advances on thinking and reasoning tests by age 4½, but only if moved into foster care. In contrast, abandoned kids who stay only in institutions experience declines on the same tests over time and many nearly qualify as mentally retarded by age 4½.

Psychologist Charles A. Nelson III of Children's Hospital Boston and his colleagues randomly assigned 136 Romanian orphans residing in any of six institutions either to stay in those settings or to receive foster care from families recruited and trained by the researchers. Until now, studies of institutionalized children have not been able to exclude the possibility that only the healthiest, smartest youngsters get adopted or put in foster care.

Children placed in foster care before age 2 made the largest intellectual gains when tested at ages 3½ and 4½, Nelson's team reports in the Dec. 21 *Science*. Their scores approached those of 72 Romanian children who had lived with their biological parents from birth.

Nelson's group presented its early findings to Romanian officials, who then passed a law that prohibits institutionalizing children under 2 years old, unless a child is severely handicapped. By the end of the study, only 20 of 68 children remained in institutions.

The rest had been adopted, returned to their biological families, or placed in foster care through a new government program. —BRUCE BOWER

GENETICS

Down syndrome's anti-tumor effect

People with Down syndrome face a heightened risk of developing leukemia (*SN*: 12/22/07, p. 402), but some studies hint that people with the condition might be protected against solid-tumor cancers.

A study in mice now shows that the chromosomal abnormality that causes Down syndrome might harbor a genetic aberration that protects against colon cancer.

People with Down syndrome have three copies of chromosome 21 instead of the normal two. One of the genes on chromo-

some 21 is *Ets2*. Past research indicated that the protein encoded by *Ets2* regulates as many as 200 genes, says study coauthor Roger Reeves, a geneticist at the Johns Hopkins Medical Institutions in Baltimore. He wondered whether *Ets2* might exert the reputed anticancer influence.

To test the idea, Reeves and his colleagues crossed mice carrying a mutation known to cause colon cancer with mice that had the third chromosome as well as with others that didn't. Those with the third chromosome developed roughly half as many tumors as the other mice, the researchers report in the Jan. 3 *Nature*.

When the researchers scaled back the *Ets2* gene to one or two copies instead of three, the mice lost much of their protection against tumors. The findings suggest that the extra proteins encoded by the third *Ets2* gene and possibly another nearby gene provide this protective effect, Reeves says.

"We're now testing this in other kinds of cancers," he says, "and looking for small molecules that elevate *Ets2* expression." —NATHAN SEPPA

NANOTECHNOLOGY

Energy forest

Thickets of microscopic silicon wires can dramatically boost the storage capacity of batteries, at least in the lab.

Lithium-ion batteries power most modern portable gadgets. During use, lithium ions detach from carbon sheets in an anode and migrate to a cathode. During recharge, the lithium ions make the opposite trip.

A carbon anode can accommodate about one lithium ion for every six carbon atoms. On the other hand, scientists have long known that silicon-based anodes could store more lithium—increasing the battery's capacity—by binding about four lithium ions per silicon atom. However, lithium absorption disrupts the diamondlike crystalline structure of silicon, says Yi Cui, a materials scientist at Stanford University. The material swells to four times its original volume and tends to pulverize.

Cui and collaborators have now created a battery with anodes made of 100 nanometer-wide silicon wires. During the first charge cycle, the nanowires swell, but do not break apart. Their thickening is permanent, enabling the nanowires to keep absorbing and releasing large amounts of lithium. "Using nanowires, we are solving this problem of volume expansion," says Cui.

He says his team's batteries can hold up to 10 times more lithium in their anodes than carbon-based batteries. With no changes on the cathode side, that means a twofold improvement in energy storage.

The team's results, published online in December, appear in the January *Nature Nanotechnology*. —DAVIDE CASTELVECCHI



ANCIENT SAP Amber from France's Oise River basin contains quesnoin, a substance whose precursor is made in abundance by a tree found today only in the Amazon Basin.

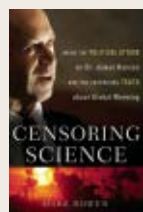
Books

A selection of new and notable books of scientific interest

CENSORING SCIENCE: Inside the Political Attack on Dr. James Hansen and the Truth of Global Warming

MARK BOWEN

Reports of U.S. presidential administrations' successful attempts to discredit and censor scientific evi-



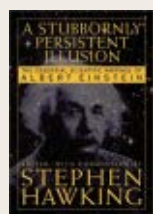
dence about global warming over the past 3 decades have come to light since 2005. James Hansen, director of NASA's Goddard Institute for Space Studies and professor of earth sciences at Columbia University, testified to the Senate in 1988 that global warming required immediate attention. In the years that followed he was repeatedly silenced by government agencies.

Hansen's complete story is now told by writer and physicist Bowen, author of *Thin Ice*. The tale covers the science behind climate change, how to mitigate its effect, and the struggle that Hansen faced to get public attention. The book quotes an e-mail sent to Hansen from a NASA administrator that advised: "One way to avoid bad news: stop the measurements!" **Dutton, 2008, 324 p., hardcover, \$25.95.**

A STUBBORNLY PERSISTENT ILLUSION: The Essential Scientific Works of Albert Einstein

STEPHEN HAWKING, ED.

In exploring the vast and complicated terrain of Albert Einstein's writings, it is surely wise to bring along a guide. And none is more qualified than



Stephen Hawking, the physicist widely known for his best-selling book *A Brief History of Time*. Hawking not only selected the entries for this collection of Einstein's writings but also offers a brief introduction to each section. Among the entries are Einstein's key papers, talks, and book chapters that highlight

essential aspects of the special and general theories of relativity. Briefer selections are provided from Einstein's writings related to quantum theory and other issues, such as the relationship of physics to reality and the "laws of science and the laws of ethics." The volume includes Einstein's autobiographical notes, written near the end of his life, that provide an engaging account of how his childhood curiosities drove him to inquiries that overturned humankind's conception of the cosmos. **Running Press, 2007, 468 p., hardcover, \$29.95.**

MIRAGE: Napoleon's Scientists and the Unveiling of Egypt

NINA BURLEIGH

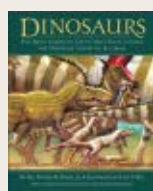
When Napoleon invaded Egypt in 1798, he brought along some 150 civilian specialists, including astronomers, botanists, chemists, engineers, mathematicians, and even an opera singer. Journalist Burleigh tells the story of Napoleon's Egyptian expedition through the eyes of its scientists and engineers. As the venture unraveled, the savants coped

with insurgencies, plague, military politics, and an international dispute over who owned their notes and specimens. Remarkably, some science did get done. Biologists studied mummies and crocodiles. Joseph Fourier started thinking about heat conduction. The savants' most widely known discovery, an inscribed stone discovered in the town of Rosetta, ended up in the hands of the British. Yet when the survivors of the expedition finally limped home, Egypt indeed had become less mysterious. **Harper-Collins, 2007, 286 p., b&w illustrations, hardcover, \$25.95.**

DINOSAURS: The Most Complete, Up-to-Date Encyclopedia for Dinosaur Lovers of All Ages

THOMAS R. HOLTZ JR.

Dinosaurs ruled the Earth for about 170 million years, and paleontologists have discovered and



named more than 800 of them. This volume offers brief, easy-to-understand entries on all known dinosaur species. But it doesn't stop there. In chapters on dino biology, reproduction, diet, and social behavior, Holtz, a vertebrate paleontologist, and dozens of other dinosaur specialists

describe how scientists figure out what dinosaurs looked like and how they evolved. Other chapters recount the history of dinosaur discoveries, the science behind dinosaur art, and how paleontologists assign scientific names to the dinosaurs that they discover. Paleontology, the author notes, has evolved too: In the early days shovels, hammers, and chisels were the tools of choice, but today's researchers often rely on electron microscopes, X-ray scans, and sophisticated software. Written for young people, this book is packed with enough detail to satisfy even diehard dinophiles. **Random House, 2007, 428 p., b&w and color illustrations, hardcover, \$34.99.**

BANANA: The Fate of the Fruit That Changed the World

DAN KOEPEL

Did Eve tempt Adam by proffering not an apple but a banana? Why is *banana republic* much more than a colorful synonym for certain Central American



nations? Koeppel presents a concise yet comprehensive account of America's favorite fruit snack. In a volume that combines history and science, he describes the banana's origins and cultural lore that surrounds the fruit. Some of the science is surprising: The banana "tree" is actually the world's largest herb, and the fruit

itself is a giant berry. Some of the science is alarming. The banana is a seedless fruit. It is grown by cloning, meaning that every banana is a genetic twin of every other. This makes the fruit easy to breed and transport, but it also makes the plants susceptible to disease. And today a fungal infection called Panama disease is ravaging banana crops on several continents. The future of the fruit may well lie in the lab, as plant scientists and geneticists strive to create a hardy, yet tasty strain. **Hudson Street Press, 2008, 281 p., b&w illustrations, \$23.95.**

LETTERS

Shades of meaning

In "Going Coastal: Sea cave yields ancient signs of modern behavior" (*SN: 10/20/07, p. 243*), researcher Curtis Marean refers to Stone Age people using a reddish pigment for "body coloring or other symbolic acts." What reason is there for jumping to this conclusion? As with cave painting and figurines, there seems to be an undue emphasis on symbolism and a supposition that everything has to have "meaning," particularly a religious or protoreligious significance. But may people not have used body coloring just for fun? We ourselves often do not know why we do certain things, or do not wish to acknowledge our trivial intentions, and therefore overlay them with deeper significance.

STEPHEN E. SILVER, SANTA FE, N.M.

Hedge fund

"Eastern farms have native bee insurance" (*SN: 11/24/07, p. 333*) says that patches of uncultivated land provide a haven for native bees that can help with pollination. Flowering hedgerows, as used in England instead of fences, would also ensure a source of wild bees as well as a refuge for wild bird populations.

ROGER W. OTTO, SAN MATEO, CALIF.

Word of pain

"Knuckle fever" reaches Italy" (*SN: 10/27/07, p. 270*) says that *chikungunya* means "stooped over in pain" in an African dialect. But which one? Africa has a thousand languages, many of which have more than one dialect.

POL SHWINGK, CARLISLE, IOWA

The word comes from the language of the Makonde people of eastern Africa, although it has sometimes been labeled erroneously as Swahili. —N. SEPPA

Postfix for a prefix

As a biochemist and a type 1 diabetic of 24 years, I enjoyed your article on beta cell research ("The Long Road to Beta Cells," *SN: 12/15/07, p. 378*). However it contained one serious error: After the majority of insulin-secreting beta cells are destroyed, HYPERGlycemia (not HYPOglycemia) results.

ALLISON B. MOORE, WILMINGTON, DEL.

The reader is correct. Untreated diabetes leads to hyperglycemia, or high blood sugar levels. We regret the error. —EDITORS

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QC2 headphones.

you'll think you're onstage with the band." The QC3 and QC2 headphones are also easy to take with you, since they fold flat for easy storage in a slim carrying case.

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