

Oxygen-Free Animals | Moonless Space Plan | 9/11's Lung Effects

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ MAY 8, 2010

SPECIAL ISSUE

The Beam Goes On

50 years of lasers

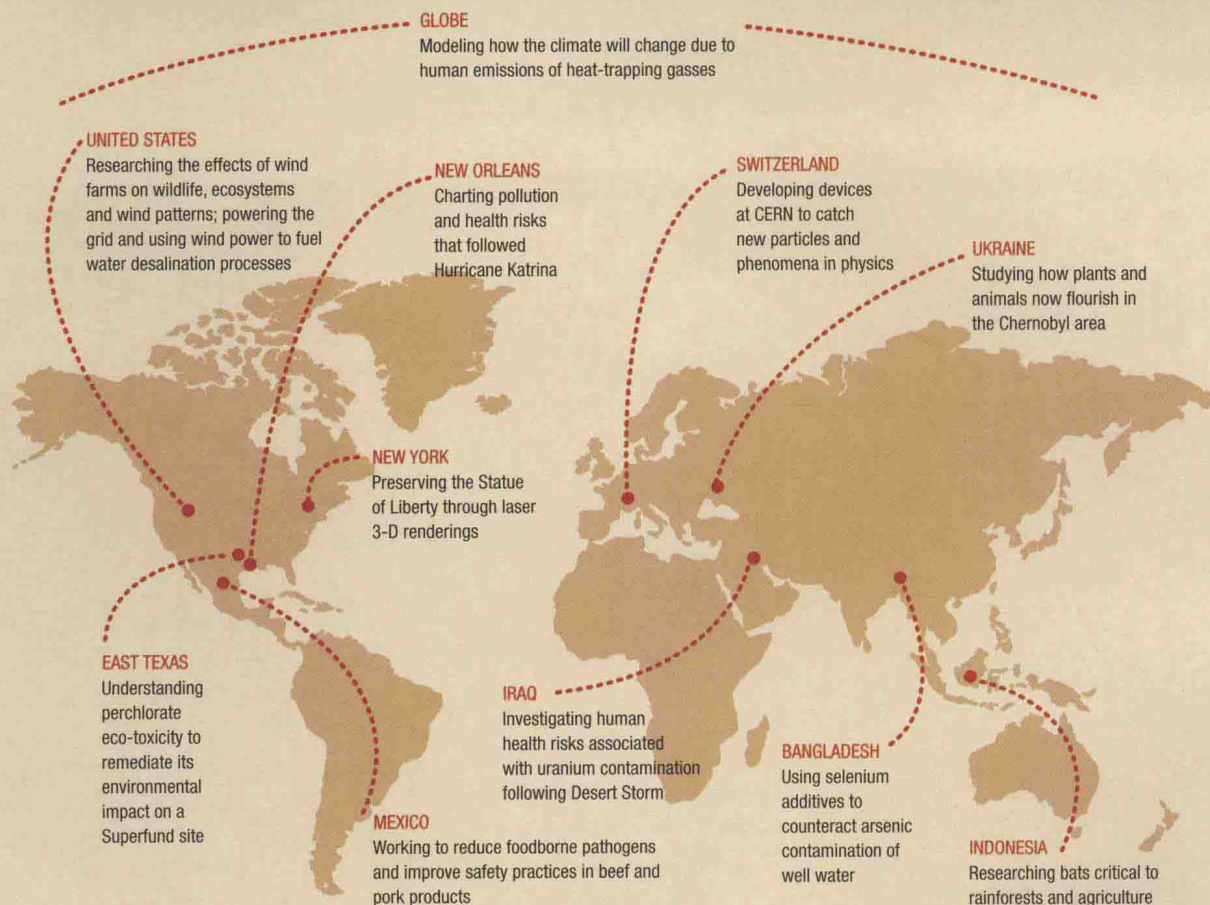
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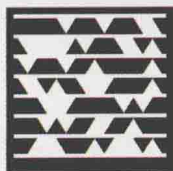
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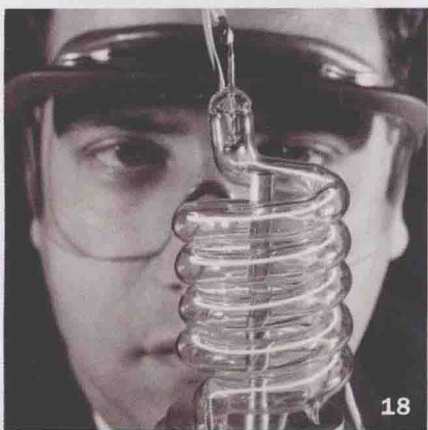
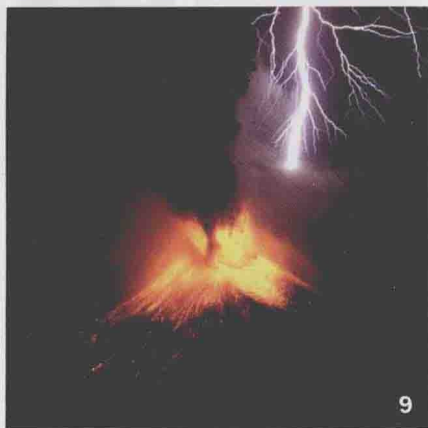
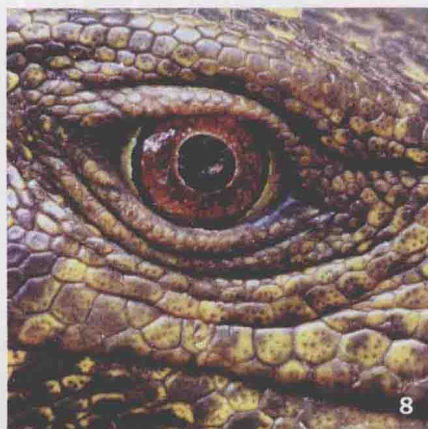
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ScienceNews

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Special Issue

Celebrating the Laser

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An idea that began with Albert Einstein inspired a race to create a special beam of light that has since infiltrated numerous aspects of everyday life.

By Ron Cowen

PLUS: Details of how lasers work, a timeline of how they came to be and a survey of the many ways they are used today.

28 LASING BEYOND LIGHT

Laser physicists have set their sights on new types of waves — manufacturing beams of sound, creating plasma swells and looking for ripples in spacetime.

By Lisa Grossman

PLUS: The biggest, baddest lasers around

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Nobel Prize-winning physicist Charles Townes describes his role in the invention of the laser.



COVER A fish-eye view of the Gemini Observatory shows its laser system creating an "artificial star" as a telescope reference.
Kirk Pu'uohau-Pummil, Imiloa Astronomy Center of Hawai'i

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FROM THE EDITOR

Lasers illuminate benefits of basic science research



Basic science's advocates are always encountering people obsessed with practical applications. Research without practical purpose, seeking knowledge for knowledge's sake, somehow never seems to escape being labeled a luxury by budget cutters and skeptical naysayers.

But for the past half century, scientists confronting the critics of basic research funding have had at their disposal a piercing one-word rejoinder: lasers.

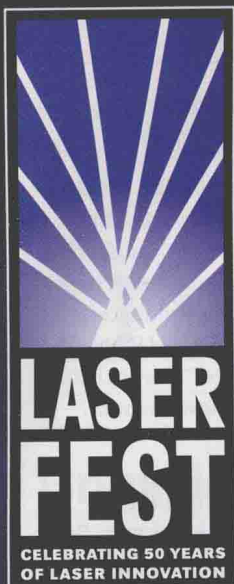
From the purest of scientific reasoning, pondering the intricate interplay of atoms, electrons and light, Albert Einstein conceived the principle behind the laser and published a paper about it in 1917. He had no thoughts of death rays, CD players or supermarket cash registers. He simply sought scientific insight. But the ultimate payoff was eminently practical: Einstein's idea eventually led to one of the 20th century's grandest technological tours de force.

Five decades ago, as Ron Cowen recounts in this issue (Page 18), Theodore Maiman made Einstein's idea real, initiating the age of the laser — a new tool for science and a new technology for society. Building on the maser, the microwave version of Einstein's idea, Maiman demonstrated that light could mimic the sharp beam of microwaves developed a few years earlier by Charles Townes (see Page 36) and others. In the 50 years since Maiman's surprising accomplishment (*SNL*: 7/23/60, p. 53), lasers have become the shining example of useful technology born of natural curiosity. From laser printers and bar code readers, chemical sensors and special microscopes to multiples uses in medicine and industry (fiber-optic communication, welding, eye surgery), the laser's applications have paid basic science's debt to society several times over.

Beyond their practical and valuable technological uses, lasers have enabled advances in many realms of basic research, from allowing physicists to trap and study individual atoms to powering experiments for testing the foundations of quantum physics. And as Lisa Grossman reports (Page 28), scientists continue to create new versions of lasers and to find novel applications for old ones. It's safe to say that in the decades to come, lasers will continue to play a starring role in both the practice of science and in science's service to society.

—Tom Siegfried, Editor in Chief

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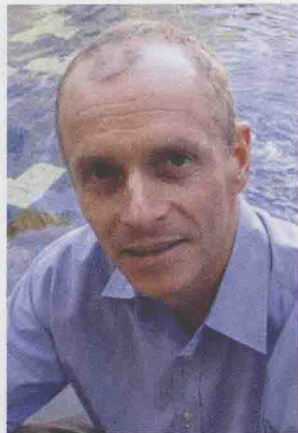


2010 LASERFEST

Help celebrate the laser's 50th anniversary with LaserFest! In a yearlong series of events and programs throughout 2010, LaserFest showcases the widespread impact of the laser and highlights its potential for the future. The American Physical Society, the Optical Society of America, SPIE and the IEEE Photonics Society have come together to organize an array of fun and educational activities around the globe ranging from public lectures to live rock shows.

Visit www.LaserFest.org to watch videos, learn about amazing laser applications, hear stories from laser science pioneers, and see how you can join the festivities!





Scientific Observations

"Even if we eventually come up with a computational account of how the social brain works that is truly aligned with the neuroscience data, it remains an open question what such an account would look like. It is possible that it would be so different from our intuitive categories for social behavior that it would literally be something that we could not presently understand.... We may end up with a theory of social behavior very different from the one we currently use in everyday

life. On the other hand, the picture of the physical world that quantum mechanics provides shares these same considerations, and it is an intriguing possibility that a future social neuroscience would literally allow us to understand ourselves in an entirely different way." —**CALTECH NEUROBIOLOGIST RALPH ADOLPHS** IN A REVIEW OF THE BURGEONING FIELD OF SOCIAL NEUROSCIENCE IN THE MARCH 25 *NEURON*

Science Past | FROM THE ISSUE OF MAY 7, 1960

WHISTLING SWANS DYED TO STUDY MIGRATION ROUTE —

The U.S. Fish and Wildlife Service has been dyeing whistling swans vivid colors to learn more about their migratory movements. With their wings, tails or other body parts colored blue, yellow, green or red, the swans are easier to observe both when flying and resting on the ground. The Service is interested in determining over which states the birds fly in their annual migrations.... Actually only a very small sampling of the whistling swan population is being dyed. This is because of the difficulty in trapping the four-foot-long birds. Mass dyeing, however, is not considered necessary. The dyes used normally do not remain on the swans for very long.



Science Future

May 12

Students can visit scientists or conduct their own experiments to celebrate National Lab Day. Find local events at www.nationallabday.org

May 27–30

The Association for Psychological Science hosts its annual meeting in Boston. See www.psychologicalscience.org

June 4–8

The American Society of Clinical Oncology meets in Chicago. See www.asco.org

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DELETED SCENES BLOG

The hardest part of finding element 117 might have been the paperwork to ship radioactive test materials from the United States to Russia. See "The backstory behind a new element."

LIFE

Pigeon navigation is largely a meritocracy. See "Pigeons usually let best navigator take the lead."



BODY & BRAIN

Top jaw, bottom jaw, the brain responds similarly to toothaches in both places. Read "Why a rotten tooth is hard to find."

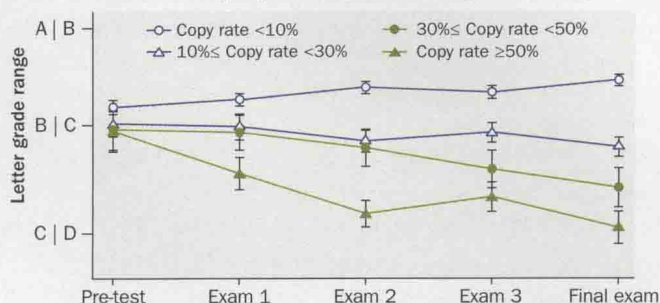
ATOM & COSMOS

The spacecraft Cassini has snapped the first images of lightning on Saturn. See "Stormy weather on Saturn" for story and video.

Science Stats | CHEATERS NEVER LEARN

A study of MIT students found that those who copied others' homework more frequently did worse on exams over the course of a semester.

Exam scores per percent of homework problems copied



SOURCE: D. PALAZZO ET AL./PHYSICAL REVIEW SPECIAL TOPICS - PHYSICS EDUCATION RESEARCH 2010

The (-est)

Researchers have identified how a few molecules beat the heat to form the smallest known superconductors. Defined as materials with no electrical resistance below certain temperatures, superconductors were thought to exist only in the macroworld; at microscopic scales, materials would get too hot. But an analysis of a known organic superconductor found that the special property was preserved in just four pairs of its molecules (shown), an international team reports online March 28 in *Nature Nanotechnology*.



“ Essentially these insects are swimming through the air. ” —ITAI COHEN, PAGE 8

In the News

STORY ONE

Briny deep basin may be home to animals thriving without oxygen

New species would extend the limits of multicellular life

By Susan Milius

Marine creatures resembling something out of a Dr. Seuss book may be the first multicellular animals known to live their whole lives without oxygen.

If further work bears out the remarkable powers of these organisms, part of a group known as loriciferans, the discovery could shake up thinking about the limits of animal life, says study coauthor Roberto Danovaro of the Polytechnic University of Marche in Ancona, Italy.

Previously loriciferans have been reported scattered around the globe living in sediment grains beneath regular, oxygenated water—and the creatures were thought to be rare.

Now Danovaro, Reinhardt Kristensen of the Natural History Museum of Denmark in Copenhagen and colleagues report that abundant loriciferans belonging to three new species turned up in sediment cores pulled from the bottom of a briny, acidic and sulfurous basin of oxygen-starved water deep in the Mediterranean Sea.

Molecular tests indicate the animals were alive when collected, and investi-

gations under microscopes suggest the species may be especially adapted to life without oxygen, the researchers argue online April 6 in *BMC Biology*.

“This discovery is truly exceptional,” says invertebrate biologist Gonzalo Giribet of Harvard University, who was not part of the study. Biologists know of animals living in extreme places, with alarming amounts of salt or scorching heat, “but not of any other animals that live without oxygen,” he says.

Loriciferans look like tiny cups with tentacles sticking out. Because they are so different from other animals, these oddballs have their own phylum, on a par with mollusks and arthropods. Kristensen described the phylum in 1983 (*SN*: 10/8/83, p. 229).

Before the team pulled up these cores, scientists had found only single-celled organisms living in oxygen-free zones, Danovaro says. These residents include bacteria and some protozoans, such as ciliates.

So far work has suggested that multicellular animals showing up in places without oxygen are just visitors passing through. Thus, biologists have thought that developing an anoxic lifestyle is hard for such organisms.

Finding a full-time multicellular resident of oxygen-free zones “would be a

Life Fruit flies turn with little trouble

Matter & Energy Charge from a dustup

Atom & Cosmos Coolest brown dwarf

Body & Brain Troubled lungs after 9/11

Humans New hominid proposed

Genes & Cells Brain network, fly-style

Numbers Figuring rope’s twists and turns

watershed for how we can think about where animals live,” says Tim Shank of Woods Hole Oceanographic Institution in Massachusetts. He studies tube worms and other animals that thrive around deep ocean vents releasing sulfide-choked plumes of water too hot to hold oxygen. Even there, Shank says, the animals need cooler water swirling in to provide oxygen.

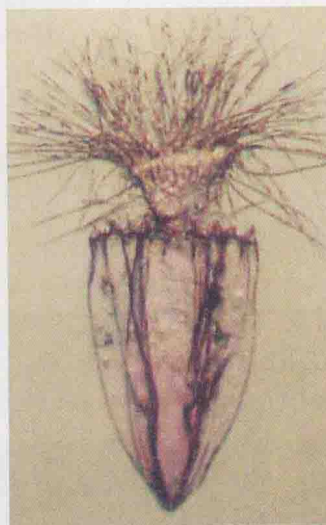
If animals really can live totally oxygen-free, Shank says, it would be “a step beyond” even the marvels of vents.

Deep-sea researchers may have many more surprises ahead of them, too. “The bottom of the sea is one of the least known ecosystems we have,” says biologist Jim Barry of the Monterey Bay Aquarium Research Institute in Moss Landing, Calif.

It was during three expeditions to survey life in such deep waters that Danovaro and his colleagues found the loriciferans, 3.5 kilometers or so below the Mediterranean Sea’s

surface in the hostile L’Atalante basin.

Salt was concentrated in the Mediterranean when it became closed off from the Atlantic about 6 million years ago. Upon reconnection hundreds of thousands of years later, pools of concentrated brine remained trapped in the L’Atalante and other deep basins. Conditions in the



Loriciferans are so different from other animals that they have their own phylum. Researchers now suggest that some species (one shown) live entirely without oxygen.



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SN Today at www.sciencenews.org

sampling spots are harsh enough to corrode sensors, Danovaro says.

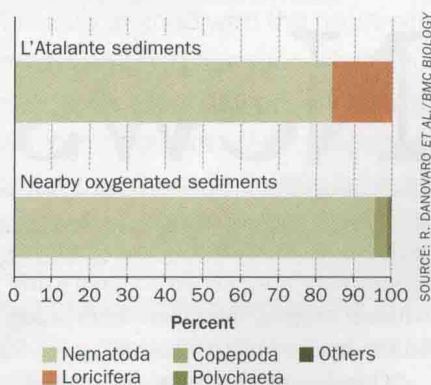
When the researchers first found the loriciferans in the sediment, "we thought they were cadavers," he says.

To see if the loriciferans had just wafted down after dying elsewhere, researchers brought up more sediment cores and tested them in nitrogen-filled incubators on ship. In molecular tests, the animals appeared to be alive and metabolizing. For example, an amino acid injected into the mud turned up in loriciferan tissues after four hours.

The presence of cast-off skins in the cores also suggests that the loriciferans are growing on location. They may be reproducing there too: Two individuals' bodies carried eggs, Danovaro says.

Also, he points out that the loriciferans, not even a millimeter long, have limited mobility, so it's unlikely that they'd move out of the sediment and through the 50 meters of anoxic water above them to take a breath in the oxygenated zone. Thus, the researchers argue, it's most likely that the loriciferans in the muck are not just visiting the basin but

Mediterranean sediment residents



SOURCE: R. DANOVARO ET AL./BMC BIOLOGY

Loriciferans were relatively abundant in the sediment pulled from beneath the salty, oxygen-deprived L'Atalante basin, but they didn't show up in sediment from nearby oxygenated waters.

have made it their full-time home.

The evidence may be indirect, but "I think they're right," says Lisa Levin of Scripps Institution of Oceanography in La Jolla, Calif.

Electron microscope images show that loriciferans' cellular innards look adapted for a zero-oxygen life, says Danovaro. The cells don't appear to

have mitochondria, which use oxygen to generate energy. Instead, images of loriciferan tissue reveal what look like hydrogenosomes, organelles that help power some known anaerobic single-celled creatures.

And near the hydrogenosome-like bits, the loriciferans have rod-shaped structures that could be symbiotic organisms. Some one-celled creatures depend on such organisms to take the hydrogen, along with other products, from the hydrogenosomes and turn it into user-friendly metabolites for the host cell (*SN*: 4/18/98, p. 253).

The research team may indeed have found multicelled creatures living in anoxic conditions, but the evidence for those creatures having hydrogenosomes still looks preliminary, cautions Johannes Hackstein of Radboud University Nijmegen in the Netherlands, who studies the organelles. Electron micrographs of tiny structures aren't enough, he says, without physiological experiments and staining of cell parts.

Figuring out how loriciferan biology works is the next step, Danovaro says. ■

Back Story | TOUGH CREATURES

Some oxygen-reliant animals find a way to get the gas even in hostile environments.



Tardigrades

Tiny, tubby invertebrates sometimes called "water bears" or "moss piglets" are the only animals so far to have lived through experimental exposure to the vacuum of space. When deprived of oxygen, the creatures survived in a dormant state—as they do on Earth when their wet homes become barren of oxygen or supersalty. And the creatures can withstand another crisis, too: They shrivel up to resist drought and revive themselves unharmed.



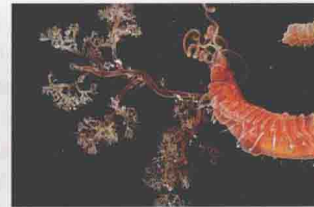
Hydrothermal vent clams

Clams that survive near hydrothermal vents position themselves in very particular ways to get both food and oxygen. The creatures extend a foot into the oxygen-starved streams of sulfide flowing from the vent. (The streams nourish the symbiotic microbes in the clams' gills, which in turn nourish the clams.) The clams also sit in a way that keeps their siphons extended into oxygenated water; the siphons direct the water over the creatures' gills.



Humboldt squid

Also called jumbo squid, these predators grow to 2 meters in length and can travel at 25 kilometers per hour. Off the coast of California, they routinely dive down to hunt in oxygen-poor water and spend all day there, outlasting other visiting hunters including sharks. Lab experiments from ships have revealed that the squid can slow their oxygen consumption rate down by 80 to 90 percent, quite a feat for an active and muscular predator.



Polychaete worms

These marine relatives of earthworms and leeches come in a variety of forms. Some have adapted to zones of oxygen-starved ocean water and sport outsized structures that increase their body surface area for gas exchange. The species of terebellid polychaete shown above has enlarged, branched cirri, or branchiae, that help it flourish in an oxygen-minimum zone 412 meters deep on the Pacific side of Costa Rica.

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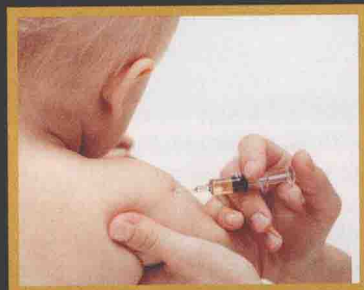
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Life



To view a video of the fruit fly's nimble turns, visit www.sciencenews.org/fly_turn

Fruit flies maneuver on autopilot

High-speed video reveals clues to insect aerodynamic skills

By Lisa Grossman

Fruit flies turn in midair with a shrug of their shoulders and nary a thought.

Flies' aerial gymnastics are driven by wing joints that act like windup toys, letting the bugs use air drag to whirl around almost automatically, a new analysis shows. Insights from the study, published online April 5 in *Physical Review Letters*, could someday help build better flying robots.

Fruit flies beat their wings about once every four milliseconds—faster than their neurons can fire electrical signals—and can turn 120 degrees in 18 wing beats. Such skills made physicists at Cornell University wonder how much of the wing motion is controlled by the insect and how much is controlled by aerodynamics.

To investigate, the researchers set up three high-speed cameras trained at the center of a box holding about 10 flies. A fly crossing the center of the box triggered the cameras to start rolling at 8,000 frames per second. At the same time, LED lights projected a rotating striped pattern on the inside of the box to trick the flies into making a U-turn.

"The flies see this, and it makes them dizzy," says study coauthor Attila Bergou of Brown University in Providence, R.I., who worked on the study as a Cornell graduate student. "It generates very reliable and repeatable turns in these flies."

The physicists analyzed the videos to extract detailed information on the wings' positions with respect to the body.

"I was surprised that they were able to get it to work as well as they did," comments Ty Hedrick of the University of North Carolina at Chapel Hill. "Getting the uncertainty of these measurements low enough that you can see what you need to see is difficult."

When a fruit fly turns, one wing tilts more than the other, the team found,



Studies combining a computer model and high-speed images show how flies "swim" in air, using drag forces to turn.

similar to the way a rower pulls one oar harder than the other to make a boat turn. Thanks to aerodynamics, a wing-tilt difference of just 9 degrees is enough to send a fly off in another direction.

"Essentially these insects are swimming through the air, using drag forces to row themselves in whichever direction they want," says study coauthor Itai Cohen of Cornell.

Computer models of the fly and aerodynamic simulations showed that the fly's wing joint acts like a torsional spring, the kind found in windup toys or old clocks. To change its wing tilt and set up a turn, all the fly has to do is twitch the muscle that controls the spring.

"The insects don't have to do any thinking whatsoever," Cohen says. "They have a natural system that provides just the right amount of torque to the wing."

Cohen hopes these findings and further studies of other insects could help in designing flying robots that take advantage of insect aerodynamic skills.

"We're in the dark ages as far as building anything like that," Cohen says. "We're nowhere in the ballpark."



Scientists name elusive new lizard

Scientists couldn't see the lizard for the trees. But now they've tracked down and named *Varanus bitatawa*, a skittish reptile that grows up to 2 meters long and sports bright yellow speckles. On the Philippine island of Luzon, the monitor lizard hauls itself up into trees in search of fruit and melts into the vegetation if humans approach, says herpetologist Rafe Brown of the Biodiversity Institute at the University of Kansas in Lawrence. He and colleagues name the species in a paper published online April 7 in *Biology Letters*. The species is "new to us," Brown clarifies, because the Agta and Ilongot peoples living in the Sierra Madre mountain range know the lizard well—as a delicacy. Western scientists first glimpsed the monitor in 2001 but could not secure a full-grown specimen. Then, in 2009, a team led by Brown and graduate student Luke Welton got its hands on an adult. DNA tests confirmed that it differs from a previously identified fruit-eating monitor living on a different part of the island. —Susan Milius

Matter & Energy



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When dust swirls and lightning zaps

How swarming particle clouds can build up electrical charge

By Alexandra Witze

It's the ultimate love-at-first-sight story: In the middle of the desert, hundreds of miles from anything else, lonely sand grains meet up in a crowd and decide to electrify each other. Sparks fly.

Physicists have long wondered how sand grains and other small particles can build up electrical charges as they collide with one another, sometimes to the point of discharging lightning in dust storms or plumes of volcanic ash. Now, a paper appearing online April 11 in *Nature Physics* suggests that particles transfer electrical charge vertically during a smashup, such that positive charges move downward and negative charges move up in the cloud.

The findings could help combat a wide variety of practical problems, such as the adhesion of charged dust to solar panels on a Mars rover or the generation of dangerous electrical discharges that can occur when a helicopter takes off in the desert. Dust clouds can create problems in grain silos, where charge sometimes builds up and leads to explosions, and in the pharmaceutical industry, where powdered drugs can become charged and not mix properly, says Hans Herrmann, a materials researcher at ETH Zurich.

Herrmann says he became interested in the problem after watching lightning in the swirling sands over dunes at night. "Normally when particles collide, they neutralize," he says. "How could it be that charges increase?"

Working with ETH colleague Thomas Pächt and Troy Shinbrot of Rutgers University's campus in Piscataway, N.J., Herrmann developed a model to explain the charging. Before colliding, the grains have an overall neutral charge but are polarized by a background electric field, with a negative charge toward the top of the grain and a positive charge toward

the bottom, relative to the ground. Upon colliding, the particles neutralize each other at the point of contact. But when they separate again they become further polarized, with additional charges building up on the grains' edges.

"Every time there's a collision you end up pumping charge from the top to the bottom," Shinbrot says. The researchers ran computer simulations and then a series of experiments with glass beads to confirm the theory.

Daniel Lacks, a materials physicist at Case Western Reserve University in Cleveland, says the new study might not be the whole story.

Lacks has shown that electrical charging depends on particle size, with smaller grains tending to charge



Flying ash sparked lightning during this volcanic eruption in Indonesia in 1995.

negatively and larger particles positively.

"The bottom line is that something is needed to break the symmetry when two particles of identical composition collide, in order for one particle to charge negatively and the other to charge positively," he says. For particles of different sizes, he says his mechanism might be in play; for identically sized particles, the new model may be the explanation. ■



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Martian meteorite's age reduced

But famous rock is still oldest known sample of Red Planet

By Lisa Grossman

Though it's still the oldest chunk of Mars ever found, the Allan Hills meteorite — officially known as ALH84001 — is about 400 million years younger than previously estimated, new research suggests.

An analysis in the April 16 *Science* pegs the rock's age at a mere 4.091 billion years. Previously it was thought to have formed 4.51 billion years ago, when the planet's surface was still solidifying. The new age indicates that the rock would have formed during a later, more chaotic period when Mars was being pummeled by rocky space debris.

ALH84001 has been a lightning rod for controversy since scientists announced in 1996 that the meteorite might hold fossils of Martian bacteria. The scientific community has since mostly abandoned that idea, as one by one every



The Mars rock ALH84001 made headlines in 1996 when scientists reported that it might contain fossil bacteria.

line of evidence for life has been given a nonbiological explanation.

The older age was calculated by measuring radioactive isotopes of samarium and neodymium, found mostly in phosphate minerals that succumb relatively quickly to weathering and geological processes, says study coauthor Thomas Lapen of the University of Houston. Like hair dye or a fake ID, weathering disguised the rock's age, but only superficially.


Lapen's group looked at different elements, lutetium and hafnium, which are found in more change-resistant compo-

nents of the rock. This method gave the meteorite a younger age.

Rocks from the early solar system are valuable for understanding the planet's composition at that time. "This is the only sample in that age range," Lapen says.

Surprisingly, the researchers also found that several younger meteorites have essentially the same composition as ALH84001, meaning that some of the same basic geologic processes have been at work on Mars for almost its entire history.

"That connection is perhaps the most amazing outcome of this research," Lapen says. "Mars is a very steady state planet. Igneous processes were happening the same way 4 billion years ago as they are happening right now."

The new age places the rock's birth during a time when the inner planets in the solar system were being bombarded with rock chunks. That provides a new explanation for why parts of ALH84001 show signs of having melted and reformed, says Allan Treiman of the Lunar and Planetary Institute in Houston. At the older age, it was a puzzle how the rock got its scars if the damage happened before the bombardment. "There's not a lot of time for that," Treiman says. 

Not your father's space program

Obama leaves the moon off his new road map for NASA

By Ron Cowen

Speaking at NASA's Kennedy Space Center April 15, President Obama outlined a new plan for the space agency that would forgo sending astronauts back to the moon. Instead, NASA would send humans to an asteroid in 2025 and into orbit around Mars a decade later.

The strategy would rely on private aerospace companies to ferry crew and


supplies into space. It would also cancel a program known as Constellation, which was to develop a heavy-lift rocket and vehicles to carry astronauts back to the moon, in favor of pursuing a new rocket that would take humans much farther.

"I am very happy about the introduction of new innovative commercial approaches in human spaceflight, because we've been trapped into a very bad cul-de-sac for 40 years," says planetary scientist and former NASA associate administrator for science Alan Stern of the Southwest Research Institute in Boulder, Colo.

In Obama's blueprint, NASA would get an additional \$6 billion over the next five years to develop new space technologies, refocusing efforts away from designing

space transportation vehicles. The plan would, however, keep plans to develop the Orion crew vehicle, which would be the only U.S. space transport vehicle once the shuttle is retired later this year. And in 2015, the agency would evaluate plans for a rocket that would carry astronauts into deep space.

Journeys to Mars orbit in the mid-2030s would be followed by a landing, "and I expect to be around to see it," the president told the cheering crowd.

Space-policy analyst Howard McCurdy of American University in Washington, D.C., says he's intrigued by Obama's willingness to leapfrog smaller goals and aim for Mars. "It's a high-risk proposition," McCurdy says. 

"Everyone is going to want to jump on this finding." —J. DAVY KIRKPATRICK

Stellar neighbor is a cool slacker

Nearest brown dwarf barely hot enough to bake a potato

By Ron Cowen

The solar neighborhood is riddled with object failures, a new study suggests.

Astronomers have found the nearest known brown dwarf, or failed star, residing about nine light-years from Earth.

That places this brown dwarf among the 10 nearest stellar or substellar systems, researchers report in an article posted online April 5 at arXiv.org. The object's temperature, about baking temp in a home oven, makes it not only

the nearest but also the coolest brown dwarf known.


"Everyone is going to want to jump on this finding," says brown dwarf observer J. Davy Kirkpatrick of Caltech, who was not part of the discovery team.

Astronomers calculate that brown dwarfs should be at least as common as stars in the Milky Way. The new finding, combined with recent discoveries of other nearby brown dwarfs, suggests that the solar neighborhood is rife with these dim bodies. The nearest body to the solar system may be a brown dwarf rather than a bona fide star, says theorist Gibor Basri of the University of California, Berkeley.

Philip Lucas of the University of Hertfordshire in England and his colleagues discovered the dim body, dubbed UGPSJ0722-05, in a sky survey con-

ducted with the United Kingdom Infra-Red Telescope atop Hawaii's Mauna Kea. Follow-up spectra recorded by the Gemini North Telescope, also on Mauna Kea, revealed that water vapor and methane in the object absorbed light more strongly than the coolest known brown dwarfs, an indication that the newfound body is even cooler. The team estimates its temperature is 125° to 225° Celsius.

Like all brown dwarfs, the object isn't heavy enough to sustain the nuclear burning that occurs in the cores of stars. Yet brown dwarfs are thought to form in the same way that stars are born, from the gravitational collapse of a molecular cloud of gas.

Lucas declined to comment on the study because he and his colleagues have submitted their paper to *Nature*. 

Backward planets flipped into place

Earthlike bodies likely to have been kicked out in the process

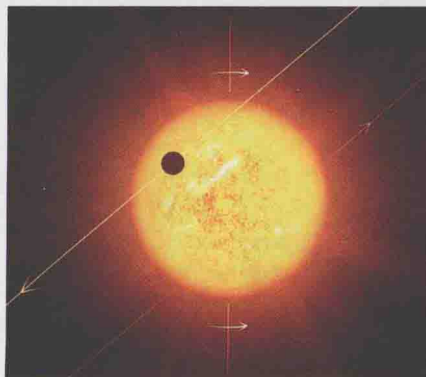
By Lisa Grossman

A recently discovered bevy of backward-orbiting exoplanets decreases the odds of finding Earthlike bodies near them, says astronomer Andrew Collier Cameron of the University of St. Andrews in Scotland.

That's because the wrong-way planets probably got where they are through a process that also would have hurled any incipient terrestrial-type planets into deep space, he proposed April 13 at a meeting in Glasgow, Scotland, of the Royal Astronomical Society.

Planets are thought to form from the disk of gas and dust around a young star. Because both star and disk coalesce from the same cloud of material, theory holds that both should spin in the same direction — as should any planets that arise.

Last summer, astronomers first discovered a handful of planets that orbit opposite the direction of their stars' spin (*SN*: 9/12/09, p. 12), as well as a number of others that have "forward" orbits



Earthlike planets are unlikely to coexist with backward-orbiting "hot Jupiters."

tilted 20 degrees or more with respect to the stellar disk in which the planets were born. These exoplanets belong to a class called hot Jupiters — giants that sit scorchingly close to their stars.


The presence of so many slanted and reversed orbits among hot Jupiters is the hallmark of a scenario known as the Kozai mechanism, Cameron said. In this scenario, a second, distant large body like

a planet or a companion star gravitationally perturbs a planet's orbit, tilting it with respect to the star's rotation. The planet's orbit can tilt so much that it flips over the top of the star like a jump rope. When the orbit is flipped more than 90 degrees, the planet actually orbits backwards.

Earthlike planets are unlikely to survive such a process. The giant planets can take hundreds of millennia to settle down, "during which you have a ram-paging Jupiter on a cometlike, crazy tumbling orbit, which would simply fling any remaining debris out of the system," Cameron said.

Earlier research predicted that most orbits of giant planets perturbed by the Kozai mechanism should end up tilted around either 40 degrees — a forward but slanted orbit — or 140 degrees — a backward and tilted orbit.

"That looks very much like what we're now observing," Cameron said. "It looks almost too good to be true."

Some critics think he's right — it is too good to be true. "Their data isn't that definitive to eliminate any other possibilities," says Adam Burrows of Princeton University. 

Body & Brain



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Health effects of 9/11 continue

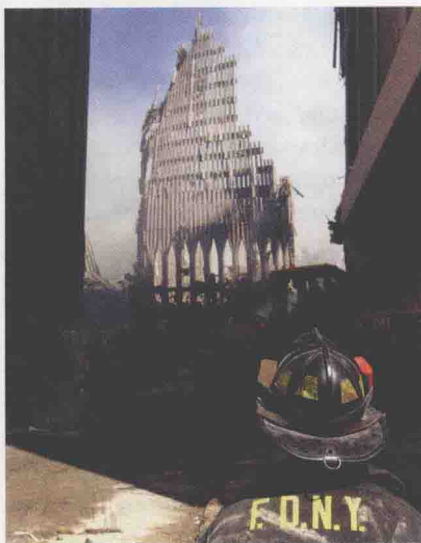
Emergency workers are still having breathing problems

By Nathan Seppa

Many rescue workers who responded to the 2001 World Trade Center attack in New York City continue to show breathing difficulties that haven't improved in the years since the dust cleared, researchers report in the April 8 *New England Journal of Medicine*.

Inhalation of the thick dust has caused bronchitis, asthma and symptoms of chronic obstructive pulmonary disease such as shortness of breath, says study coauthor Thomas Aldrich, a pulmonologist at Albert Einstein College of Medicine in New York City.

Aldrich and his colleagues analyzed results of lung function tests of 10,870



Lung function remains below normal for many September 11 rescue workers.

firefighters and 1,911 emergency medical service workers examined both before and after the attack. The sample included 92 percent of all rescue workers who arrived at Ground Zero

between September 11 and September 24.

Of nonsmoking firefighters, 3 percent had below-normal lung function before 9/11, but that rose to 18 percent in 2002 and has since stabilized at 13 percent. Among nonsmoking EMS workers, 12 percent fell below normal range before the attack compared with 22 percent in 2002, a percentage that has been constant since then. Firefighters who arrived on the morning of 9/11, when dust was densest, were most likely to have diminished lung capacity within the first six months to a year.

"In the first 24 hours, there weren't many respirators there," says environmental scientist Paul Liroy of the Robert Wood Johnson Medical School in Piscataway, N.J. In any case, Liroy says, "these people went in to save lives; they weren't thinking about the dust."

Since there have been few biopsies of lung tissue in these workers, the precise nature of the lung disease is unclear. But inflammation probably plays a role, Aldrich says.

Insulin-producing cells regenerate

Mouse experiments suggest potential diabetes treatment

By Tina Hesman Saey

Replacements for some diabetics' missing insulin-producing cells might be found in the patients' own pancreases, a new study in mice suggests.

Alpha cells in the pancreas can spontaneously transform into insulin-producing beta cells, researchers report online April 4 in *Nature*. The study is the first to reveal the pancreas's ability to regenerate missing cells. Scientists were surprised to find that new beta cells arose from alpha cells in the pancreas, rather than from stem cells.

If the discovery translates to people, scientists may one day be able to coax type 1 diabetics' own alpha cells into replacing insulin-producing cells. Type 1 diabetes, also known as juvenile

diabetes, results when the immune system destroys beta cells in the pancreas. People with the disease must take lifelong injections of insulin in order to keep blood sugar levels from rising too high.

Researchers treated mice to destroy their pancreatic beta cells and kept the mice alive by giving them insulin. After six months, the mice no longer needed the injections because their pancreases had regenerated between 4 percent and 17 percent of the beta cells present before the treatment — enough to maintain nearly normal blood sugar levels.

"It's very early and very basic research right now, but it opens up the idea that reprogramming is not just something we have to force cells to do, that it's an intrinsic property," says Andrew Rakeman, a scientific program manager

for the Juvenile Diabetes Research Foundation in New York City who was not involved in the study.

The researchers found that some of the insulin-producing cells also made glucagon, a hormone that is normally made by alpha cells. The finding suggested that the beta cells in the mice had once been alpha cells.

To test that hypothesis, the researchers tagged alpha cells in mice, then killed their beta cells. Newly generated beta cells carried the alpha cell tags, indicating that a switch had occurred.

If humans can perform the conversion, says study coauthor Pedro Herrera of the University of Geneva, controlling the immune system attack in type 1 diabetics could give their pancreases a chance to recover at least some function. "The life of diabetics would change even if the pancreas is only able to produce 1 or 2 percent of normal insulin levels," he says.

"These people went in to save lives; they weren't thinking about the dust." —PAUL LIQY

Eating seaweed gives gut a boost

Bacteria enable some Japanese to digest the indigestible

By Susan Millus

Eating seaweed appears to give some Japanese people digestive superpowers.

Bacteria in the guts of some Japanese people can break down porphyran, a compound in seaweed that is normally indigestible, scientists report in the April 8 *Nature*. The microbes may provide nutritional benefit to these people, says study coauthor Gurvan Michel, a biochemist at the Biological Station of Roscoff in France.

After discovering genes for a pair of porphyran-digesting enzymes in the marine bacterium *Zobellia galactanivorans*, Michel's team searched for similar DNA sequences in other species. The team found a partial match in a gene from


a human gut bacterium and eventually showed that porphyran-digesting bacteria were in samples from Japanese subjects but not in samples from Westerners.

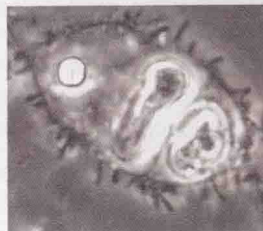
The human gut bacteria probably acquired the gene centuries ago from marine microbes hitchhiking through the intestines on the seaweed abundant in the Japanese diet, Michel says.

"To our knowledge, it's the first time there has been a demonstration of gene transfer from bacteria outside the gut to bacteria within the gut in connection with food," he says.

Ruth Ley of Cornell University notes that there has been speculation about whether such gene transfer occurs. But she can't think of any other work that has showed this and done it "so beautifully."

All people rely on gut microbes for the tricky parts of digesting land plants, such as breaking down polysaccharides, a family of compounds that includes marine algae's porphyran. "When you digest a salad, it's not you that breaks down the vegetables; it's the bacteria in your gut," Michel says.

Land plants don't make porphyran, but it shows up in seaweeds such as the dried, dark nori in sushi. Japanese people have eaten seaweed for centuries and today on average consume 14 grams daily. 



***Zobellia galactanivorans* bacteria look like eye-lashes growing on the outside of a brown alga.**

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Humans



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Hobbit fuss goes out on some limbs

Debate over pint-sized fossils turns to arm and leg bones

By Bruce Bower

ALBUQUERQUE — Two fossil “hobbits” have given what’s left of their arms and legs to science.

But that wasn’t enough to quell debate over hobbits’ evolutionary status at the annual meeting of the American Association of Physical Anthropologists.

Since 2004, the discoverers of these unusual fossils on the Indonesian island of Flores have attributed their find to an ancient pint-sized hominid, *Homo floresiensis*, that survived there until 17,000 years ago — a shockingly recent date in human evolutionary terms.

Critics say the finds represent nothing more than human pygmies like those still living on Flores. If so, the centerpiece hobbit find — a partial female skeleton known as LB1 — is what’s left of a woman who suffered from a developmental disorder that resulted in an unusually small body and brain.

But arm and leg bones from LB1 and another hobbit appear healthy, concludes a study led by William Jungers of Stony

Brook University in New York. The bones display normal thickness in the tissue that forms the outer shell of most bones, as well as symmetry that signals healthy growth, said Stony Brook anthropologist and study coauthor Frederick Grine, who presented Jungers’ paper on April 17.

The scientists also found that *H. floresiensis* limb strength rivals that estimated for ancient hominids such as the 3.2-million-year-old *Australopithecus afarensis*, a.k.a. Lucy. That suggests hobbits could engage in arboreal acrobatics and other vigorous activities that humans generally can’t manage. Hobbits may have spent much time climbing trees, as Lucy’s kind did, the researchers propose.

In a separate presentation, Robert Eckhardt of Pennsylvania State University in University Park conjured an entirely different animal from the very same bones. He argued that a developmental disorder produced a suite of skeletal abnormalities in LB1 (*SN*: 11/18/06, p. 330), including irregularly shaped hip joints and tube-shaped upper leg bones.


A variety of developmental disorders



The limb bones of the LB1 hobbit, shown in cast, can be read two ways.


produce skeletal traits in people today that Jungers has labeled as exclusive to *H. floresiensis*, Eckhardt argued. He described the case of a woman with a developmental disorder that resulted in an S-shaped collar bone, which Jungers’ team lists as a hobbit-specific feature.

This new twist in the hobbit controversy follows the March 17 online publication of a paper in *Nature* concluding that hominids reached Flores before 1 million years ago. Excavations on Flores yielded stone tools from sediment dating to that time, reported Adam Brumm of the University of Wollongong in Australia.

Brumm’s contention has been challenged by colleagues who believe natural processes may have moved the artifacts from younger to older sediment layers. 



Hominid species named

Nearly 2 million years ago, an adult and child walking in the South African landscape fell through an opening in an underground cave and died. That plunge has now led to the identification of a new hominid species. In the April 9 *Science*, anthropologist Lee Berger of the University of the Witwatersrand in Johannesburg and colleagues assign the fossils to a new species, *Australopithecus sediba*, and propose that it served as an evolutionary bridge from apelike *Australopithecus* to the *Homo* genus, which includes living people. In a local African tongue, *sediba* means fountain or wellspring. “*Australopithecus sediba* could be a Rosetta Stone for anatomically defining the *Homo* genus,” Berger says. But others doubt that the newly discovered fossils will illuminate *Homo* origins. “There’s no compelling evidence that this newly proposed species was ancestral to *Homo*,” says Bernard Wood of George Washington University in Washington, D.C. — Bruce Bower 

FROM TOP: MAMORITA/FICKR; BRETT ELOFF; COURTESY L. BERGER/UNIV. OF WITWATERSRAND

8000
B.C.Date of oldest known
preserved human hair
with traces of lice**430**
B.C.Herodotus describes
Egyptian priests' lice-
control methods

MEETING NOTES

Thumbs-up on precision grip

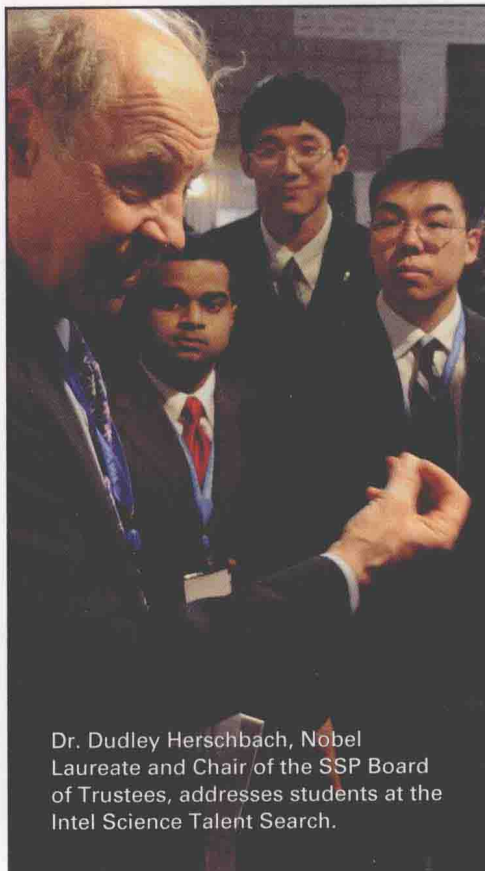
A tiny fossil thumb bone provides a gripping new look at the early evolution of human hands. An upright gait and relatively sophisticated ability to manipulate objects apparently evolved in tandem among the earliest hominids at least 6 million years ago, Sergio Almécija of the Autonomous University of Barcelona reported April 16. That's well before the earliest evidence of stone toolmaking, which dates to about 2.6 million years ago, countering the idea that skills for toolmaking drove the evolution of opposable thumbs. Almécija and colleagues studied a bone from the tip of a thumb belonging to *Orrorin tugenensis*, which at an estimated 6 million years old is the second oldest reported

hominid genus. The fossil indicates that *Orrorin* had a long enough thumb to meet the tips of the other fingers, allowing fine manipulation of objects. By comparing *Orrorin*'s thumb bones with those of other hominids, ancient apes and living people, Almécija found a pattern that argues against the notion that hominids first evolved handier hands as they learned to make stone tools. In Almécija's view, early hominids inherited hands capable of fine manipulation from small-bodied apes that lived in Africa and Europe between 25 million and 5 million years ago. Russell Tuttle of the University of Chicago, who had predicted that early hominids would have had a relatively sophisticated grip, called the new analysis unsurprising.

—Bruce Bower

Lice make the clothes, and man

For once lice are nice, at least for scientists investigating the origins of garments. DNA evidence suggests that body lice first evolved from head lice about 190,000 years ago—soon after people first began wearing clothing, researchers propose. The new estimate, presented April 16, sheds light on a development that allowed people to settle in northern, cold regions, said Andrew Kitchen of Pennsylvania State University in University Park. His team examined mitochondrial and nuclear DNA from head and body lice to estimate when body lice appeared. Because body lice thrive in the folds of clothing, they probably appeared not long after clothes were invented, many scientists believe. —Bruce Bower



Dr. Dudley Herschbach, Nobel Laureate and Chair of the SSP Board of Trustees, addresses students at the Intel Science Talent Search.



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