COV.12-20 12/17/03 14:37 Page 1



DECEMBER 20 & 27, 2003 PAGES 385-416 VOL. 164, NOS. 25 & 26 SEMIANNUAL INDEX; NEWS OF THE YEAR

> a cool, new view of space no more brazil nuts? sophisticated stone age art ash found at new heights

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**Mystery WORD STATISTICS REVEAL AUTHORS** 

#### THE WEEKLY NEWSMAGAZINE OF SCIENCE

# SCIENCE NEWS

DECEMBER 20 & 27, 2003 VOL. 164, NOS. 25 & 26

#### Features

- **392 Bookish Math** Statistical tests are unraveling knotty literary mysteries by Erica Klarreich
- **395 Undignified Science** Well-intentioned research often takes unseemly turns by Bruce Bower

#### This Week

- 387 Orbiting telescope views infrared universe by Ron Cowen
- **387** Lupus patients exhibit signs of heart disease by Nathan Seppa
- **388 Severe storms can lift smoke into stratosphere** by Sid Perkins
- 388 Liquid crystal sensor plays nature's game by Alexandra Goho
- 389 German cave yields Stone Age figurines by Bruce Bower
- **389 Vibrated goo mimics slithery motions** by Peter Weiss
- **390 Brazil nut harvest may be too heavy to last** by Susan Milius

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#### THIS WEEK ONLINE www.sciencenews.org

**Cold comfort?** Neither conventional medicines nor echinacea cut the duration or severity of colds in children. See Janet Raloff's Food for Thought.



#### Of Note

**397** Dune leapfrogging is deciphered Glow with the flow Did rivers once run on the Red Planet?

Baboons demonstrate social proficiency

**398** Warning issued for trauma debriefing Hard mattresses not best for back pain

#### Meetings

**398** Drug particle delivers insulin on demand New materials take the heat

#### Departments

- 399 Books
- 399 Letters
- 400 Crossword Puzzle
- 401 Science News of the Year
- 410 Semiannual Index

**Cover** The statistics of authors' uses of common words, such as *to* and *upon*, can reveal who wrote disputed works. Page 392

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# SCIENCE NEWS This Week

#### **Cool Cosmos** Orbiting telescope views infrared universe

Astronomers this week unveiled some really cool images—along with some positively chilling spectra. The new images include pictures of a hidden stellar nursery and the first spectra ever taken of organic material in a remote galaxy. An infrared observatory, the Spitzer Space Telescope, had gathered the data since its launch last August.

The telescope "will change the way astronomers do astronomy," predicts John N. Bahcall of the Institute for Advanced Study in Princeton, N.J. With Spitzer's infrared capability, "it will no longer be astronomically correct to characterize a system by only X-ray, optical, or ultraviolet light," he adds.

Previously known as the Space Infrared Telescope Facility and now renamed in honor of the late astronomer Lyman Spitzer Jr., the telescope records infrared radiation from some of the coldest, remotest and most-dustobscured objects in the universe. It does so with higher resolution and greater sensitivity than any other infrared telescope sent into orbit, notes Spitzer project scientist Michael W. Werner of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. At a NASA press briefing, he and several of his colleagues presented images and spectra from Spitzer's first few months of operation.

Peering at a brilliant but dust-shrouded galaxy more than 3 billion light-years from Earth, Spitzer detected an abundance of organic compounds, including frozen carbon monoxide, carbon dioxide, water, methane, and polycyclic aromatic hydrocarbons. The telescope recorded the organic compounds in the galaxy as it appeared 3.25 billion years ago, a time when primitive life had just gained a foothold on Earth.

The new finding suggests that "the building blocks [of life] are spread around the universe," says Spitzer astronomer James R. Houck of Cornell University.

Looking closer to home, Spitzer has taken the first infrared image of a disk of dusty debris surrounding the bright star Fomalhaut, which is 25 light-years from Earth. Debris disks represent the spray of material generated by the collision of asteroids or comets, dust-rich leftovers from the planetmaking process. Although telescopes that detect longer, submillimeter wavelengths already have imaged the outer part of Fomalhaut's disk (*SN: 4/25/98, p. 260*), Spitzer is the first observatory to provide a full picture of the disk, says Karl R. Stapelfeldt of JPL.

The disk's outer region, which has a radius



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**SEEING (INFRA)RED** Top: False-color, infrared view of a glowing stellar nursery in the Elephant's Trunk nebula. Bottom: Inner (yellow-green) and outer (orange) parts of a debris disk surround the nearby star Fomalhaut.

of about 150 times the Earth-sun distance, roughly corresponds to the relative location of a reservoir of comets near our solar system's edge. The newly imaged inner region of the disk comes as close to Fomalhaut as Saturn does to the sun and may mark the location of an inner asteroid belt circling the star, notes Stapelfeldt.

Spitzer found that one section of the outer part of Fomalhaut's disk was noticeably brighter than the other and so has a higher dust concentration. The gravitational influence of an unseen planet could be responsible, notes Stapelfeldt.

Elsewhere in the Milky Way, Spitzer viewed a dark, elongated globule known as the Elephant's Trunk nebula. The infrared images reveal several embryonic stars as well as young but fully formed stars. In visible light, these stars are hidden by dust and dense gas. —R. COWEN

### **Cardiac Connection**

Lupus patients exhibit signs of heart disease

**Doctors have long suspected that people** with lupus have a heightened risk of heart attack. Now, two major studies reveal more early signs of atherosclerosis in the blood vessels of people with the autoimmune disease than in healthy participants.

Inflammation is the logical link between heart disease and systemic lupus erythematosus, the condition's formal name. A raft of studies over the past decade has tied inflammation to subtle artery injuries that can lead to atherosclerosis (*SN:* 4/20/02, *p.* 244; 12/6/03, *p.* 366). In lupus patients, the immune system seems to assault its own tissues, sending inflammatory proteins to the skin and elsewhere. This gives rise to the rash, joint pain, fatigue, fever, anemia, and organ failure that mark the disease.

In one of the new studies, researchers used ultrasound to examine the neck arteries of 197 lupus patients and 197 apparently healthy individuals of matching age, gender, race, and blood pressure. The ultrasound revealed that 37 percent of lupus patients, but only 15 percent of the control group, had small atherosclerotic plaques along the inside lining of the carotid arteries.

The result was more dramatic when the authors accounted for differences in the two groups, such as cholesterol-test results and whether the participants smoked, says study coauthor Mary J. Roman, a cardiologist at Weill Medical College of Cornell University in New York. In that analysis, the lupus patients were five times as likely as the others to have budding atherosclerosis, she and her colleagues report in the

### SCIENCE NEWS This Week

Dec. 18 *New England Journal of Medicine*. In the other new study, researchers used computerized tomography to spot calcium build-up in coronary arteries. Such deposits can reveal hidden atherosclerosis (*SN*: *9/13/03*, *p. 174*).

Rheumatologist C. Michael Stein of Vanderbilt University School of Medicine in Nashville and his colleagues report in the same journal that 20 of 65 lupus patients, but only 6 of 69 healthy volunteers, had calcium deposits in a coronary artery. The difference held up even when the team accounted for known heart attack risk factors.

Many lupus patients take anti-inflammatory medication to suppress flare-ups of their symptoms. Roman and her colleagues found that lupus patients free of plaques in their carotid arteries were more likely to have taken strong anti-inflammatory drugs, such as prednisone, than were patients who had plaques. The studies contradict a widely held opinion that long-term use of prednisone and other steroids accelerates atherosclerosis, says physician Bevra Hannahs Hahn of the University of California, Los Angeles in the same issue.

Hahn says the two new studies indicate that "more aggressive control of [lupus] might help prevent atherosclerosis."

Curiously, Roman says, blood analyses of participants in her study didn't show excess inflammatory proteins in lupus patients compared with other volunteers. Therefore, while the findings solidify the link between lupus and atherosclerosis, she says, they don't pin down inflammation as its cause.

Inflammatory proteins are ephemeral, flooding the system during a lupus flareup but subsiding otherwise, Stein says. It could be that lupus patients in the throes of a flare-up were unlikely to volunteer for these studies, he adds. —N. SEPPA

### Ash Clouds

Severe storms can lift smoke into stratosphere

New field observations, satellite images, and computer models are steering some scientists toward a surprising conclusion: A severe thunderstorm, enhanced by the heat from a huge forest fire, can boost soot, smoke, and other particles as high as the lower stratosphere. The newly suspected transfer of aerosols to high altitudes could require sig-



nificant changes in computer models of atmospheric circulation and climate.

Most of Earth's weather—and most of its air pollution—resides in the troposphere, the layer of atmosphere that extends from the planet's surface to altitudes between about 8 and 13 kilometers. Previous studies suggested that most particles floating in the stratosphere, the next-highest atmospheric layer, come from volcanic eruptions or are generated on the spot by high-flying aircraft, says Pao K. Wang of the University of Wisconsin–Madison.

Scientists generally hadn't suspected that thunderstorms can transport particles across the troposphere's well-defined upper boundary, but a wealth of observations is challenging that view, Wang told an audience last week in San Francisco at the fall meeting of the America Geophysical Union.

Consider the flurry of carbon-bearing particles encountered by a high-flying NASA research jet early this year. On flights near Kiruna, Sweden, instruments detected such aerosols at concentrations of up to 1 microgram per cubic meter. That's more than 30 times the amount that can be accounted for by commercial aircraft, says Darrel Baumgardner of the National Autonomous University of Mexico in Mexico City. Elevated concentrations of carbon monoxide and other gases in air samples bolster the notion that the particles came from forest fires, he says. Baumgardner presented his findings at last week's San Francisco meeting.

Also, satellite observations last summer showed that hundreds of fires across the Northern Hemisphere sometimes strengthened nearby thunderstorms, which then apparently pumped immense plumes of smoke and soot into the stratosphere. Some of those long-lasting plumes could be traced intact for distances exceeding 5,000 km, which suggests that many of the particles were in the stratosphere, riding high above weather systems that could have brought them back to the ground, says Michael D. Fromm, a meteorologist with the research firm Computational Physics in Springfield, Va. Similar plumes from intense fires near Canberra, Australia, reached the stratosphere in January 2003, he says.

Computer models of ash columns spouting from a large forest fire show that the extra heat can invigorate storm clouds that pass over or form nearby, says Wang. Strong updrafts in the storms can then carry plumes of smoke and soot that burst into the stratosphere, the simulations indicate.

Even small numbers of particles in the stratosphere can have significant effects on climate, says Wang. For instance, Baumgardner's analyses suggest that the concentrations of sooty aerosols found over Sweden could boost absorption of incoming solar radiation in the lower stratosphere in winter months by as much as 15 percent.

No current models of atmospheric circulation or climate incorporate the effects of fire-enhanced thunderstorms injecting particles or gases into the stratosphere, says Wang. —S. PERKINS

#### **Crystal Clear** Liquid crystal sensor plays nature's game

Thanks to billions of years of evolution, cells are remarkably adept at detecting pathogens or toxic chemicals in the environment. Taking advantage of this natural surveillance capability, researchers have incorporated components of cell membranes into sensors to sniff out dangerous chemical and biological agents.

Led by chemical engineer Nicholas L. Abbott at the University of Wisconsin– Madison, the researchers placed a layer of phospholipids—the fatty acids constituting cell membranes—on top of a liquid crystal. "These are the same liquid crystals you find in laptop-computer displays," says Abbott.

In the new sensing scheme, the lipids attach themselves to the rod-shaped liquid g crystal molecules, which lie perpendicular ≸ to the surface and appear dark. When the researchers expose the sensor to an aqueous stream containing a protein that binds to lipids, the liquid crystal molecules respond within seconds by switching to a planar orientation. Viewed under a microscope, the crystals then transmit polarized light and appear bright.

"This is a beautiful example of how one can use novel materials to create a signal," says Chad Mirkin, a chemist at Northwestern University in Evanston, Ill.

By adding different receptors to the lipids, researchers can tune the sensor to detect specific molecules. For instance, when Abbott and his colleagues attached a receptor called biotin to the lipids, the sensor detected a bacterial protein that binds to biotin. The researchers describe their results in the Dec. 19 *Science*.

Abbott's team has made sensors out of liquid crystals before (*SN: 8/18/01, p. 103*), but those sensors didn't include membrane components. When attached to fluid lipid molecules, receptors can move about freely instead of being fixed in one place.

"That becomes important for binding things like viruses," which attach to several receptors at once on cell surfaces, says Abbott. Mobile receptors in the artificial sensors can reorganize to bind specific targets just as receptors in a cell do.

Because the sensors don't require electric power, Abbott envisions deploying networks of coin-size devices for long-term monitoring in the field. Researchers could shine a laser on the sensors to determine the orientation of the liquid crystals. Says Abbott: "You could interrogate the sensors from 1,000 feet away on the ground or from a helicopter."

Although the sensitivity of the new sensor is not yet as high as that of others in development, the device is part of a new generation of inexpensive, sophisticated



**LIQUID SWIRL** Inside this gold grid, each tiny square of liquid crystal measures 280 microns across and is topped with lipid membranes. The crystals polarize light and change from dark (left) to a colorful soap-bubble appearance (right) when exposed to a target molecule. sensors, says Mirkin. Existing sensors are not sufficient in this new era of homeland security, he adds.

The Wisconsin group is currently increasing the sensitivity of its device and focusing on detecting dangerous molecules, such as cholera toxins and chemical and biowarfare agents. —A. GOHO

#### **Bones of Invention** German cave yields Stone Age figurines

**Excavations in caves in southwestern** Germany are carving out a new chapter in art prehistory. Most recently, researchers sifting through dirt that had been dug out of the Hohle Fels cave uncovered three tiny figurines that were sculpted from mammoth ivory between 35,000 and 30,000 years ago.

The figurines, each nearly as long as a

thumb, depict a horse's head, a duck or some other waterbird, and a half-lion, half-human creature. Along with the

#### FLIGHTY FIND A German cave yielded

three 30,000-year-old ivory figurines, including this water bird.

more than a dozen ivory figurines and other artifacts discovered decades ago at three nearby Stone Age cave sites, the new specimens belong to one of the oldest known art traditions in the world, says project director Nicholas J. Conard of the University of Tübingen in Germany.

"Southwestern Germany was probably one of several centers of ancient figurative art," Conard says. The new German finds come from a time when artwork began to flourish in Europe. Conard's report on the figurines appears in the Dec. 18/25 *Nature*.

Three different laboratories produced radiocarbon dates for animal bones and charcoal at the four caves. Although no fossils of *Homo sapiens* or Neandertals have turned up at these locations, Conard suspects that people entered the region around 40,000 years ago and subsequently produced the figurines. Animal remains and ivory-working debris in Hohle Fels and the other German caves indicate that they were occupied repeatedly in the winter and spring.

According to Conard, the new figurines support the controversial theory that a sizable portion of prehistoric artwork reflects shamans' supernatural rituals (*SN: 10/5/96, p. 216*). The half-man, half-lion figure—the second such sculpture found in southwestern Germany—fits with the belief that shamans can transform into certain animals, he notes. Also, traditional societies often regard water birds as spirits that usher shamans into supernatural worlds.

There are several sites in Europe and Africa harboring roughly 30,000-year-old rock and cave art, although some researchers now contend that a couple of the European locations may be only 15,000 to 20,000 years old.

Even so, the newly found figurines challenge the view that ancient art in Europe gradually evolved from simple origins, archaeologist Anthony Sinclair of the University of Liverpool in England remarks in a commentary accompanying Conard's report. "The first modern humans in Europe were, in fact, astonishingly precocious artists," he writes.

The German finds suggest that Stone Age art began with realistic depictions of the world and evolved toward other modes of expression, such as the use of geometric designs, remarks archaeologist Steven Kuhn of the University of Arizona in Tucson.

> The motivations of Stone Age people for creating the Hohle Fels figurines remain hazy, Kuhn adds.

To detect the objects' purposes, researchers must unearth more sculptures along with evidence about how the artifacts were used, he says.

It's intriguing that at least some people living 30,000 years ago spent a lot of time creating figurines, says anthropologist Mark Collard of Washington State University in Pullman. Only large groups with secure food supplies could have supported such activity, he theorizes. —B. BOWER

#### **Gel Bots?** Vibrated goo mimics slithery motions

A physicist's hunch about snail locomotion is inspiring a new way to make robots—from goop. Experiments show that matchsticksize slivers of hydrogel, the type of material used for soft contact lenses, can ooze along like snails, slither like snakes, and creep ahead like inchworms.

Greatly miniaturized robots made of hydrogel might someday shimmy across the surfaces of microchips, acting as tiny delivery carts or movable barriers. Some incarnations might glide through a person's intestines or other internal cavities collecting medical data or dispensing medication, the experimenters say.

Biomechanics specialists have long known that snails and other limbless creatures locomote by sending waves of muscular contractions down their bodies. To

### SCIENCE NEWS This Week

convert those pulsations into directional motion, the animals typically exploit transient changes in the friction between their bodies and the underlying surface, restricting propulsion to one direction, says applied mathematician Lakshminarayanan Mahadevan of Harvard University.

A couple of years ago, Mahadevan had a hunch that the type of contractile waves that snails employ is also the basis for other types of limbless locomotion. In experiments described in an upcoming *Proceedings of the National Academy of Sciences*, Mahadevan and chemical engineers Manoj K. Chaudhury and Susan Daniel of Lehigh University in Bethlehem, Pa., set water-lubricated rods of hydrogel (*SN: 5/25/02, p. 323*) into motion by applying vibrations to the rubber-coated glass plates on which they lay. Patterns of slits cut into the rubber provided the rods with frictional contact points.

The researchers found that vibrations aligned with the rods set up contractile waves like those of a snail. In these cases, the rods slid continuously forward or backward over the slits. Adding slight side-toside or up-and-down vibrations led to a buckling of the gel, resulting in snakelike slithering or inchwormlike motion, respectively.

"These are great experiments," comments Anette P. Hosoi of the Massachusetts Institute of Technology, a developer of snaillike robots for such uses as oil exploration. The link between the different slithery gaits raises the possibility of building robots that can readily match their movements to different terrains, she adds.

Although the experiments may apply to artificial mobility, some biologists say that the work doesn't add to understanding of movement of organisms. Animal-locomotion researcher R. McNeill Alexander of the University of Leeds in England says, "I think it is a different and neat way of expressing what we already understood."

Moreover, the proposed common mechanism behind the different limbless motions is not reflected in the natural world, cautions biomechanical engineer Mark W. Denny of Stanford University. "Undulation in animals is clearly a result of asymmetrical nervous excitation of muscles, not of buckling," he says.

To devise practical robots, the Harvard-Lehigh team is investigating hydrogels that would move in response to stimuli such as electric fields or chemical reactions. The team is also looking into ways to incorporate textures into the surface of the hydrogels themselves so that future gel-based robots



WILD NUTS Brazil nut trees drop grapefruit-size pods that have 10 to 25 nuts each.

might carry motion-directing frictional contacts onboard instead of relying on features of the surfaces they traverse. —P. WEISS

#### Brazil Nut LOSS LOOMS Harvest may be too heavy to last

What are now rich forest areas for harvesting Brazil nuts might wane into an impoverished old age unless harvesters change their ways, warns a large international group of scientists.

Brazil nuts alone among internationally traded seed crops come entirely from wild collections in the forest, rather than from farms. Conservationists have praised nut collection as a model for generating income from a tropical forest without destroying it.

That happy view may need rethinking, according to Carlos A. Peres of the University of East Anglia in Norwich, England, and his 16 colleagues. An analysis of tree ages in 23 spots in lowland Amazonia suggests that moderate and intense gathering claims so many seeds that not enough remain to replace old trees, the researchers report in the Dec. 19 *Science*.

Jason Clay of the World Wildlife Fund–U.S. in Washington, D.C., comments that if this threat should materialize, shrinking income might drive harvesters out of business and away from the trees. "Having people in the forest who have a vested interest in it is one of the things that can help keep the forest as it is," he says. Brazil nut trees (*Bertholletica excelsa*) grow globes enclosing up to 25 angular, brown Brazil nuts. An individual tree can yield nuts for 150 years. People gather the nuts, as do native rabbit-size rodents called agoutis.

To judge the effects of human Brazil nut harvests, Peres and his colleagues examined nut-collection sites in Brazil, Peru, and Bolivia and categorized each site as lightly, moderately, or heavily harvested. The researchers also surveyed the Brazil nut trees for size, a standard way of estimating tree ages. Some sites had many slim, youthful trees in line to replace oldsters as they die, but other sites had hardly any members of the next generation.

The researchers then performed statistical tests to see whether various environmental factors might explain the differences in tree sizes. The strongest, most consistent effect was that sites where people conduct moderate or heavy nut collection contain few new trees.

The researchers also ran a computer model predicting the size of trees in a forest where people picked all the nuts. Those results matched the tree-size data that the researchers had observed for heavily harvested sites.

Tropical-forest specialist Lourens Poorter of Wageningen University in the Netherlands cautions that it's hard to prove that a lack of new trees indicates overharvesting. "They showed it can be the case, but it's not 100 percent sure," he says.

Study coauthor Pieter A. Zuidema of Utrecht University in the Netherlands responds that the new study can distinguish causes for sapling deficits on the basis of Brazil nut biology and data from various harvest regimens. —S. MILIUS



# **BOOKISH MATH**

Statistical tests are unraveling knotty literary mysteries

BY ERICA KLARREICH

"The very thing!" exclaimed Professor Wogglebug, bounding into the air and upsetting his gold inkwell. "The very next idea!"

evotees of Frank L. Baum's classic children's books would quickly recognize the above excerpt as the opening of the 15th book in the Oz series, The Royal Book of Oz. They might be harder pressed to say whether these lines were actually written by Baum. The book appeared with Baum's name on the cover in 1921, which was 2 years after Baum's death, and it was billed as the final work of the Royal Historian of Oz. For decades, however, fans and scholars have speculated that Ruth Plumly Thompson, who took over the series after Baum died, was the true author.

A few decades ago, literary detectives might have pinned their hopes of solving this mystery on finding the proverbial dusty manuscript in the attic trunk. Today, some scholars are tackling such problems with untraditional but more widely available tools: math formulas and computer programs.

Earlier this year, statistician José Binongo of the Collegiate School and Virginia Commonwealth University in Richmond published the results of statistical tests making a compelling case that Thompson wrote The Royal Book of Oz. Binongo's paper appeared in the spring Chance, in a special issue on stylometry-the science of measuring literary style.

Stylometry is now entering a golden era. In the past 15 years, researchers have developed an arsenal of mathematical tools, from statistical tests to artificial intelligence techniques, for use in determining authorship. They have started applying these tools to texts from a wide range of literary genres and time periods, including the Federalist Papers, Civil War letters, and Shakespeare's plays.

"We can now pretty accurately identify authorship-under the right conditions," says John Burrows, an emeritus English professor of the University of Newcastle in Australia.

What's more, the tremendous growth of computer power and electronic archives of literary texts is allowing stylometrists to carry out mathematical analyses on a scale previously unimaginable.

"Stylometry has a tremendous untapped potential," says Bernard Frischer, a classicist at the University of California, Los Angeles.

LITERARY FINGERPRINTS At first glance, it might appear that the way to pinpoint a writer's style is to study the rarest, most striking features of his or her writing. After all, it's the unexpected words and the unusual rhetorical flourishes that seem to mark a

puter programming," he says.

work as uniquely Shakespearean or Dickensian. Yet the most venerable, commonly used approach of stylometrists does the opposite: It examines how writers use bread-and-butter words such as "to" and "with." Although this approach seems counterintuitive, it's based on sound logic.

He has used mathematical methods to study ancient Greek and

Latin texts. "There are hundreds of insights waiting to be discovered by scholars who will take the time to learn statistics and com-

"People's unconscious use of everyday words comes out with a certain stamp," says David Holmes, a stylometrist at the College of New Jersey in Ewing. Precisely because writers use these function words without thinking about them, they may offer more-

> reliable fingerprints of a writer's style than unusual words do.

"Rare words are noticeable words, which someone else might pick up or echo unconsciously," Burrows says. "It's much harder for someone to imitate my frequency pattern of 'but' and 'in."

In the early 1960s, statisticians Frederick Mosteller and David Wallace launched the use of function words to determine authorship. They analyzed the Federalist Papers, 85 essays published anonymously in 1787 and 1788 to persuade New Yorkers to adopt the new Constitution of the United States. Scholars have long known that Alexander Hamilton, James Madison, and John Jay wrote the essays, but both Hamilton and Madison claimed authorship of 12 of the papers.

To determine who wrote the disputed papers, Mosteller and Wallace compared word usage in other writings by Hamilton and by Madison. They found, for instance, that Hamilton used the word "upon" about 10 times as often as Madison did. Armed with 30 such distinguishing words. Mosteller and Wallace considered each disputed paper. Mosteller and Wallace started out by

assuming that for each paper, the proba-

bility was equal that Madison or Hamilton was the author. They then used the frequencies of the 30 words, one word at a time, to improve this probability estimate. They ultimately assigned all 12 disputed papers to Madison, a conclusion that dovetails with the historians' prevailing view.

Mosteller and Wallace's landmark study was the first convinc-





of The Royal Book of Oz lists Ruth Plumly

Thompson, not Frank L. Baum, as the

author. A new mathematical analysis

supports that attribution.

ing demonstration that stylometry can ferret out the authorship of a text, Holmes says. Since that time, the *Federalist Papers* has been a favorite testing ground for researchers trying out new stylometric methods.

**MANY DIMENSIONS** Although Mosteller and Wallace's study made a big splash, their techniques were not widely picked up, largely because of the shortage of computing power and machine-readable text at the time. By the late 1980s, that was changing. About this time, Burrows found a way to apply a statistical technique that has become, Holmes says, the "first port of call" for stylometrists.

Like Mosteller and Wallace, Burrows examined the frequency of function words. However, whereas Mosteller and Wallace incorporated information one word at a time, Burrows' analyzed the information from all the words in one fell swoop. Researchers have now widely adopted Burrows' technique, making various modifications along the way.

Binongo's work on *The Royal Book* of Oz is a good example. He started by collecting other samples of Baum's and Thompson's writings and breaking the samples into 5,000-word chunks. He then found the 50 most frequently used words in the body of texts and counted how often each word appeared in each chunk. This process distilled each chunk to 50 numbers.

Just as two numbers specify a point in two-dimensional space, and three numbers a point in three-dimensional space, the 50 numbers associated with each chunk of text specify a point in 50-dimensional space. Any differences in the scatter of Baum's and Thompson's points could be potential clues to the writers' different styles.

The problem is, people aren't good at visualizing spaces with more than three dimensions. So, Binongo employed a tool called principal-components analysis (PCA) to squash all the different dimensions onto a flat

plane. PCA finds the plane that captures as much as possible of the original variation in the scattered points.

There's no guarantee that a pattern will show up in this plane. In the case of the Oz books, however, a pattern leaps out. The Baum texts cluster in one half of the plane, while the Thompson texts sit in the other half, showing what Binongo calls a clear "stylistic gulf."

When chunks of *The Royal Book of Oz* are plotted in the same plane, they all land squarely in Thompson's half.

"With this unerring consistency, we have confidence in our identification of Thompson as the author of the 15th book," Binongo said in the spring issue of *Chance*.

In the same issue, Holmes reported using PCA and other function-word techniques to resolve another historical mystery, the authorship of the "Pickett letters." This collection was supposedly written during the Civil War by Confederate General George Pickett to his fiancée, but she actually wrote the letters herself, Holmes concludes.

**ARTIFICIAL SMARTS** For decades, computers have supported the work of experts in stylometry. Now, computers are becoming experts in their own right, as some researchers apply artificial intelligence techniques to the question of authorship.

In 1993, Robert Matthews of Aston University in England and Thomas Merriam, an independent Shakespearean scholar in England, created a neural network that could distinguish between the plays of Shakespeare and of his contemporary Christopher Marlowe. A neural network is a computer architecture modeled on the human brain, consisting of nodes connected to each other by links of differing strengths.

Matthews and Merriam built such a network in which the links initially had random strengths. They then trained the network by presenting it with examples of undisputed texts by Shakespeare or Marlowe. Any time the network guessed the wrong author for one of the training texts, it adjusted the strength of its links. By the end of the training period, the network could accurately distinguish between the known Shakespeare and Marlowe texts.

When the technique was applied to the entire canon of Shakespeare plays, *Henry VI*, *Part 3* was the only text that the network classified as written by Marlowe. This result lent support to the controversial view of some scholars that Shakespeare adapted the play from an earlier work of Marlowe. Several other early Shakespeare plays also showed strong Marlowe traits, although the network ultimately attributed them to Shakespeare.

> The results support the idea that "in the early 1590s, Shakespeare made the transition from actor to the most accomplished playwright of his or anyone else's era—by amending preexisting scripts by Marlowe," Matthews says.

> A couple of years later, Holmes and Richard Forsyth of the University of Luton in England used the *Federalist Papers* to test another artificial intelligence technique. They applied genetic algorithms, which use Darwinian principles of natural selection. The idea is to create a set of rules for determining authorship and then let the most useful, or fit, rules survive.

> Holmes and Forsyth began by creating 100 rules. An example of a rule might be, "If *but* appears more than 1.7 times in every thousand words, then the text is by Madison." Of course, that particular rule might do a terrible job.

Holmes and Forsyth tested each rule against known texts of Madison and

Hamilton and gave it a fitness score on the basis of how many texts it assigned correctly. They then killed the 50 least-fit rules, introduced small mutations into the surviving rules to mimic evolution, and added 50 new rules.

They repeated this process again and again until, after 256 generations, the evolved rules attributed the texts correctly. When tested on the disputed papers, the rules attributed them all to Madison, in keeping with Mosteller and Wallace's findings.

In contrast to Mosteller and Wallace's work, the genetic algorithm's final rules used only eight words. "It worked extremely well, and very efficiently," Holmes says.

Yet another analysis of the *Federalist Papers* was presented at a computer science conference in October. Glenn Fung of Siemens Medical Solutions in Malvern, Pa., used one of artificial intelligence's newest tools, a pattern-recognition technique called support-vector machines.

As does PCA, the new technique plots each chunk of text as a point in a high-dimensional space. It then searches for the best-fitting surface that divides the points belonging to one author from those of the other author. Fung's analysis used only three characteristic words—*to*, *upon*, and *would*—to successfully attribute the disputed papers to Madison.

**HABITUAL PHRASES** Although it's risky to determine authorship using rare words, they can strengthen evidence of a match. "We shouldn't dismiss the rare words, since they have as interest-



Frank L. Baum (black dots) are far separated from those of texts by Ruth Plumly Thompson (open circles). A statistical analysis places the disputed volume, *The Royal Book of Oz* (hearts), in Thompson's half of the plane. It correctly classifies *Glinda of Oz* (clubs), the last book indisputably written by Baum, in his half.

#### "Stylometrics offers vast potential for new discoveries."

-- BERNARD FRISCHER, UNIVERSITY OF CALIFORNIA, LOS ANGELES MEDICAL INSTITUTIONS ing a story to tell as the high-frequency words do," Holmes says. "Ideally, these two things should work in harmony."

For instance, in *Shakespeare, Co-Author* (Oxford University Press, 2003), Brian Vickers of the Swiss Federal Institute of Technology in Zurich uses common-word results, rare-word results, and historical information to argue that five of the plays usually included in the Shakespeare canon are in fact collaborations between Shakespeare and other dramatists.

Hugh Craig, a stylometrist at the

University of Newcastle, has been pursuing an idea, which he calls "rare pairs." He attributes it to MacDonald Jackson of the University of Auckland in New Zealand. Rare pairs are two words that, taken separately, are nothing special but which are seldom seen in close proximity.

Craig hopes that these pairs, by capturing something of an author's favorite phrases, might provide a stronger clue to authorship than individual words do. "The idea is that authors have certain habits, maybe even laid down as neural pathways, that predispose them to pair one word with another," he says. "Once one word comes into their mind, they're primed to use a second word."

As a test case, Craig has been studying a collection of scenes that were added by an anonymous author in 1602 to a play called *The Spanish Tragedy*, after its author, Thomas Kyd, was already dead. The added scenes are of high quality, Craig says, and some critics have speculated that Shakespeare wrote them.

Craig culled from an online database all the works by dramatists of the period—a collection containing nearly 17 million words. He defined a pair to be rare if it turns up at most 10 times in the database. One example in *The Spanish Tragedy* additions is *paint* and *wound*, which appear in the line "Canst paint me a tear or a wound,/ A groan or a sigh?" In the entire database, Craig found only two other uses of this pair, one by an obscure author named Sir David Murray, and the other in Shakespeare's 1594 poem "The Rape of Lucrece": "And drop sweet balm in Priam's painted wound."

Of course, a single such congruence is evidence of nothing. The idea, Craig says, is to look at many examples and see whether they point towards a particular author. Craig is currently working out how large a database is necessary and how many rare-pair matches are needed to assert the authorship of a text with confidence.

For *The Spanish Tragedy*, Craig says, the 78 rare pairs he has tested so far put Shakespeare ahead of the other favored candidates. "More work needs to be done before [the scenes] are accepted as part of future editions of Shakespeare, but I think it's quite possible they will appear there eventually," he said in a September lecture at the Massachusetts Center for Renaissance Studies in Amherst.

**STYLE LIMITS** There will always be some authorship questions that stylometry can't touch. For instance, most of the methods require the unknown text to contain at least 1,000 words. "You can't do authorship attribution on one paragraph," says Joseph Rudman, a stylometrist at Carnegie Mellon University in Pittsburgh.

It's also essential to work with clean text that hasn't been changed much over the years. Rudman notes, so stylometry can't be applied to poems from the oral tradition. "They're such a mishmash," he says.

Stylometrists dream of a technique they could use to settle any attribution problem, regardless of genre, language, or time period. In the meantime, though, the methods at hand can provide fresh insight into many literary mysteries. "Stylometrics offers vast potential for new discoveries," Frischer says. "It has a very bright future." ■



# **UNDIGNIFIED SCIENCE**

Well-intentioned research often takes unseemly turns

BY BRUCE BOWER

here's an old saying that no good deed goes unpunished. Here's a related bit of sadomasochistic wisdom: No research finding, good or not, goes public without eventually yielding unforeseen consequences that leave researchers either shaking their heads or spinning in their graves. This investigational-degenerative process has a long, colorful history. Alexander Graham Bell would have rung up his lawyer in 1876 if told that his cherished telephone would morph into a portable device for pestering innocent bystanders with the owner's private reports on what subway station he or she is entering. As if that's not enough, consider two hellish words that never occurred to Pa Bell: dinnertime telemarketing.

Or take the sad case of Thomas Edison. After cranking up the first phonograph in 1877, the great inventor must have had goose bumps as he envisioned soul-enriching music wafting through the nation's parlors and salons. Well, you got conned, Edison. Make way for cars, decorated in painted flames and Playboy mud flaps, that cruise the streets playing Eminem CDs loud enough to drown out passing ambulances.

Then there are poor James Watson and Francis Crick. They identified the structure of the DNA molecule in 1953 but forgot to patent it. These days, any competent scientist would try to corner the market on our genetic heritage. Well, it's too late. A gaggle of biotech entrepreneurs are grabbing the equivalent of the genome's Boardwalk and Park Place cards and preparing to collect what's owed them. Hey, Watson and Crick. Do not pass Go. Do not collect—oh, never mind.

The list of scientific advances later taken down a notch or two is longer than the faces of all those scientists unjustly passed over yet again by the Nobel prize committee. Rather than dwell on past misfortunes, though, let's look to the future. There's big fun in speculating about the unexpected affronts that will plague this year's research findings.

> Remember, the following indignities are futuristic fantasies. They probably err on the conservative side.

> **FINDING:** Tougher IQ tests are devised every 15 to 20 years to counteract the constant rise in average IQ scores, but in their first few years of use, the new tests pull many children from just above to just below the IQ-point cutoff for mental retardation. This effect wreaks havoc on public schools' special education programs.

**INDIGNITY:** Jennifer L. Slocumb, a struggling mother of three and freelance

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DEAN MACADAM

spot welder, sues Mensa in 2010 when the high-IQ society rejects her membership application after she scores only 148 on a revamped IQ test. "There's people in Mensa right now who'd score below me on the new test," Slocumb explains to a *Court TV* reporter. "Those effete brainiacs are gonna pay for their hubris. And hubris doesn't come cheap."

Marilyn Vos Savant, possessor of the world's highest IQ, counsels Slocumb to drop her suit and bide her time. "Mensa has to draw the line somewhere," Vos Savant remarks. "Jennifer just needs to retake the test in 12 or 13 years, when people of merely above-average intelligence can ace that bad boy."

#### FINDING: Monkeys learned to control a

mechanical arm with their minds, thanks to wires implanted in their brains that transmit electrical signals to a computer. The discovery may lead to brain implants that enable paralyzed people to control artificial limbs.

**INDIGNITY:** After weathering a bitter baseball players' strike in 2015, baseball commissioner George Steinbrenner comes up with a marketing plan to reinvigorate the national pastime. Steinbrenner's scheme: Install robotic umpires at all ballparks and sell official Major League Baseball brain implants to season ticket holders. After each pitch, fans with electrical transmitters lodged in their frontal lobes mentally duke it out to control the umpire's arms and voice. Was that last pitch a strike? Was the runner out at home? A summation of brain responses from at least 1,000 onlookers yields a final call. Fearing that their home games will grind to a halt, team owners in Detroit and Florida immediately request a system that functions on the brain activity of no more than 500 people.

**FINDING:** Chinese scientists say that they are growing massive fruits and vegetables from seeds sent into space on rockets, retrieved when the rockets return to Earth, and then planted at a research facility. The superproduce includes tomatoes as big as softballs and volleyball-size eggplants. A Chinese company plans to market 280 varieties of space seeds.

**INDIGNITY:** Chinese food stockpiles grow at an unprecedented rate until, in 2041, giant mutant fruits and veggies block Beijing's streets and clog paths and rice fields in the countryside. The government decrees that families with fewer than 10 mouths to feed "will suffer the consequences." The United States and England agree to airlift China's enormous edibles to deserted parts of Siberia. "It's not like we're dumping rubbish in someone's backyard for perpetuity," says U.K. Royal Air Force Commander Reginald Skowcroft, director of the airlift. "This oversize space produce is thoroughly biodegradable." **FINDING:** U.S. researchers determined that Vincent Van Gogh's painting titled "Moonrise" shows a lunar ascent in Provence, France. at 9:08 p.m. local time on July 13, 1889. Several clues led to this discovery: an analysis of Van Gogh's letters to his brother, computer calculations of when a full or nearly full moon would have appeared in this part of France, and in-person inspections of the locale depicted in the painting.

**INDIGNITY:** French researchers report in 2005 that U.S. artist C.M. Coolidge's "A Friend in Need"—better known as "Dogs Playing Poker"—portrays an incident of canine card cheating that took place at 1:10 a.m. on July 5, 1921.

The researchers first noted the time shown on the grandfather clock in the classic barroom-wall painting. Considering the bags under the eyes of the smiling collie, the scene undoubtedly occurred after midnight, say René Bonchien and his colleagues. In letters to his wife, Coolidge noted that the idea for the painting came to him

on a summer day, the scientists point out. In another telling clue, the St. Bernards drink bottled beer, while the two bull terriers share a glass of whiskey as well as a card under the table. "Dogs mix beer with hard liquor only on special occasions, even when playing cards," Bonchien states. "I'm thinking Fourth of July." The terriers' thick, studded collars were popular around 1921, shortly before ruffled collars for small dogs became a national fad during the Roaring Twenties, he adds.

"We couldn't track down the room shown in Coolidge's painting," Bonchien acknowledged. "To get a better feel for what this American master was up to, my associates

and I frequently played five-card stud while inebriated."

**FINDING:** Nanotechnology continued to take tiny strides of great magnitude. In perhaps the biggest development, investigators discussed the possibility of using nanotubes to build an elevator capable of ascending 60,000 miles into space.

**INDIGNITY:** Scientists actually construct a space elevator out of nanotubes in 2030. In a related and at first seemingly minor development, this research yields a nanotube space escalator that hangs in the extraterrestrial ether, gliding steps up and down spans of as many as 3,000 miles. With these key nanoconveyors in place, a research team joins forces with Fortune-500 company SpaceTime Developments Inc. to assemble the universe's first space mall for interstellar travelers. Major retailers jump at the opportunity to set up shop in the ultimate duty-free zone. NanoPrada and BananaNanoRepublic report record first-year sales from their space divisions.

A major problem remains, however. We can put a mall in space, but we don't have enough shuttle parking spaces. **FINDING:** The muscle-building supplement creatine, popular among competitive athletes and bodybuilders, was found to increase volunteers' performance on memory and analytical-thinking tasks.

**INDIGNITY:** In 2007, California Governor Arnold Schwarzenegger realizes that decades of massive creatine consumption have made him smarter than everybody except Sylvester Stallone and Lou Ferrigno. After using his pumped-up intellect to spearhead a recall of the U.S. Constitution's ban on foreign-born presidents, Arnold hits the campaign trail and gets elected commander-inchief in 2008.

He chooses his cabinet on the basis of creatine-enhanced brainpower alone: Secretary of Defense, the Rock; Secretary of State, Vin Diesel; Secretary of Labor, Jose Canseco; Secretary of the Interior, Superman; Secretary of Agriculture, the Jolly Green Giant; and Attorney General, Janet Reno.

In his first presidential news conference, Schwarzenegger announces that he has deported Jean-Claude Van Damme to France for championing the benefits of steroid injec-

tions over creatine pills.

"Van Damme pleaded with me to stay," the president tells the reporters. "You know what I told him? 'Talk to the hand."

**FINDING:** Scientists who have developed prototypes of electronic paper say that the day is fast approaching when newspapers will carry fullcolor video clips of news and sports events.

**INDIGNITY:** By 2045, all newspapers and magazines communicate solely through electronic videos narrated by attractive announcers. As a result, people stop reading altogether. Print journalism

goes the way of the dodo, as newsstand and subscription publications become broadcasting ventures.

In a sign of these tumultuous times, marked changes occur among *Science News* staff writers. Mild-mannered folk formerly obsessed with word counts and copping the lead position for their story in the week's News section exhibit a newfound interest in voice lessons and begin price shopping for blow-dryers and hair stylists. Some of the men even start to shave and bathe every once in awhile and to wear collared shirts.

All right, the scenarios are starting to get scary and perhaps a tad cynical. Let's bear in mind that sometimes science reaps wonderful payoffs. When 19th-century mathematician and inventor Charles Babbage worked on his Difference Engine and Analytical Engine, he probably didn't envisage his work as a precursor of 21st-century computer systems that would transform how families, businesses, and governments work.

Of course, Babbage probably also failed to realize that a few people whom he could have calculated rings around would gain a virtual monopoly on computer software and become unfathomably rich.

Hey, Babbage: Do not pass Go. Do not collect—oh, never mind.



SCIENCE NEWS

# OF NOTE

#### PHYSICS

### Dune leapfrogging is deciphered

Physicists have unraveled how certain wind-driven sand dunes in Morocco and Peru apparently tunnel through slower dunes.

Barchan dunes are massive, crescentshaped sand piles that move across windswept deserts at speeds up to tens of meters per year. Because smaller dunes outpace bigger dunes and eventually appear in front of them, the small dunes seem to be punching through big ones.

Such behavior has precedents: Solitary waves of light, sound, or water that pass directly through each other are known as solitons (*SN*: 11/20/99, p.327). Now, a new mathematical model for wind-driven sand, as well as computer

simulations of the same, reveal that one Barchan dune can, indeed, act as a soliton and pass through a slower-moving dune.

In the Dec. 11 *Nature*, Veit Schwämmle and Hans J. Herrmann of the University of Stuttgart in Germany outline several simulated dune behaviors, including the soliton scenario. The simulations' outcomes depend on the relative starting heights of the two dunes.

Each setting begins with a small dune rear-ending a big one. In the solitonlike case, wind dumps sand on the rear dune while shrinking the forward one. Next, the now-small, forward dune pulls away from its now-big companion. Such encounters "look exactly like soliton collisions," Hermann says, although the sand grains of one dune don't actually burrow through the other dune.

Other scenarios studied by the scientists include complete swallowing of a tiny dune by a much-larger one and the growth of baby dunes at the ends of a parent dune that has consumed an incoming, slightly smaller dune. —P.W.

### Glow with the flow

A new way to use flowing water to generate electricity may lead to gadget-size, hydroelectric batteries. So say engineers at the University of Alberta in Edmonton, who have powered a tiny lamp by driving water through channels only about twice the diameter of a red blood cell.

The new approach to electric power uses no moving parts, such as in turbines. Instead, the rush of water on a miniature scale drags positive ions downstream, creating a usable voltage difference. The prototypes built so far can power only tiny devices, such as the light-emitting diodes used as on-off indicators in electronic devices. Only about 1 percent of the mechanical energy supplied to move the water gets converted to electricity, says Alberta mechanical engineer Daniel Y. Kwok.

To make an array of water-carrying channels, Kwok and his colleagues use a commercially available ceramic filter about the size of a cookie and riddled with about a million holes. The team forces water through the holes with a syringe or pressure from a water column. The scientists tap the resulting current simply by placing electrodes in the water on either side of the filter.

Kwok and his colleagues describe their new power-generating method in the November *Journal of Micromechanics and Microengineering*. –P.W.

#### ASTRONOMY Did rivers once run on the Red Planet?

A fan-shaped region of debris on Mars is providing new evidence that the planet, now bone-dry, once had persistent rivers or lakes. Images from NASA's Mars Global Surveyor spacecraft show what appear to be ancient sedimentary deposits that have hardened into curved ridges of layered rock.

Some of the features in the region could have formed when ancient rivers meandered for vast stretches of time, says Michael C. Malin of Malin Space Science Systems in San Diego. Malin's team built and operates Surveyor's camera. The apparently water-sculpted region covers an area 13 kilometers long and 17 km wide within a crater on Mars' southern hemisphere. It lies downhill from a large network of channels that may have drained into it billions of years ago.

The fan shape of the area and the pattern of channels suggest the region may have been a delta where a river entered another body of water, Malin and coworker Kenneth S. Edgett report in an upcoming *Science*. If this interpretation proves correct, the finding "would be the strongest indicator yet [that] Mars once had lakes," Malin says. —R.C.

#### ANTHROPOLOGY Baboons demonstrate social proficiency

Wild baboons may look fierce and uncouth, but don't underestimate their social aptitude, suggest two studies in the Nov. 14 *Science*.

Previous research showed that female baboons recognize the voices of close maternal relatives. The animals can also readily tell from vocal encounters who's dominant over whom within their own families.

Biologist Thore J. Bergman of the University of Pennsylvania in Philadelphia and his colleagues wanted to know whether female baboons could also discern dominance relationships between members of their own family and those of other families in the same community.

To find out, the researchers exposed a group of females to recordings of heated vocal exchanges between female members of the listeners' community in Botswana. The animals spent more time looking toward the loud speakers when the recorded confrontations were between individuals from different families and the lower-ranking animal took the offensive. The researchers propose that such encounters attract attention because they signal possible changes in the social ranks of individuals throughout the community.

Baboons showed less interest in recordings hinting of rank reversals within the same family, perhaps because such spats have narrower social implications.

The second study, led by anthropologist Joan B. Silk of the University of California, Los Angeles, illuminates the social politics of childrearing. Female baboons who forged close ties to kin and community members largely through frequent, mutual grooming—raised substantially more than their share of infants to at least age 1, when the



SAND SLAM in a

a larger dune.

computer simulation, a

windblown dune overtakes

and seems to pass through



chances of surviving to adulthood greatly increase. Socially connected females may receive baby-friendly perks, such as protection from harassment or access to others' food, the researchers theorize. The findings come from 108 adult female baboons monitored in Kenya for 16 years. —B.B.

#### BEHAVIOR Warning issued for trauma debriefing

Efforts to get firefighters, disaster survivors, and others to talk about traumatic events immediately after such experiences, with an emphasis on venting emotions, have mushroomed in the past few years. That growth has unfolded despite the absence of evidence that such psychological debriefing actually aids recovery from highly upsetting events, according to a review in the November *Psychological Science in the Public Interest*.

Most published studies show that people who are debriefed individually or in groups just after a trauma fare no better than do those who aren't debriefed, say psychologist Richard J. McNally of Harvard University and his colleagues. No evidence exists that debriefing reduces the incidence of posttraumatic stress disorder, and some investigations suggest that debriefing distorts the natural course of psychological healing after a severe trauma, the scientists remark.

"For scientific and ethical reasons, professionals should cease compulsory debriefing of trauma-exposed people," the researchers conclude. They don't preclude the technique for those who request it, however.

For those who don't, the scientists say, cognitive-behavioral treatment delivered weeks or months after a traumatic event shows promise as a way to improve psychological adjustment. This technique focuses on reliving the trauma through imagination, addressing distorted beliefs about the trauma, and learning ways to relax. —B.B.

#### BIOMEDICINE Hard mattresses not best for back pain

Mattresses rated medium-firm are better for people with chronically sore backs than are firm mattresses, researchers in Spain find. Their report in the Nov. 15 *Lancet* contradicts the long-held view that harder is better when it comes to beds and backs.

The scientists randomly assigned 158 people to use firm mattresses and 155 to sleep on medium-firm mattresses. The mattresses—which met European standards for firmness—were delivered to the homes of the volunteers, all of whom were adults with a long history of lower-back pain. The participants rated their pain before the study and after 90 days, using a standardized scale.

People sleeping on the medium-firm mattresses had significantly less pain upon arising in the morning and less overall disability from their back pain than did people using the firm mattresses, reports a group led by Francisco M. Kovacs, a physician at the University of Barcelona and the Kovacs Foundation in Palma de Mallorca.

Although the reason for the differences remains unclear, questionnaire data show that 69 percent of the volunteers that had slept on medium-firm mattresses slumbered mainly in the fetal position by the end of the study, compared with 59 percent of the other study participants.

A fetal position may produce less back pain than other positions do, speculates Jenny McConnell of the University of Melbourne in Parkville, Australia, in the same journal. The new study suggests that doctors "may be confident in recommending a mattress of medium firmness" to patients with bad backs, she says. —N.S.

#### BIOMATERIALS

Drug particle delivers insulin on demand

Chemical engineers at the Massachusetts Institute of Technology have developed injectable polymer particles that can store and release insulin in the body in response to changes in blood-glucose concentrations.

The particles are crafted from the polymer dextran, a sugar-binding protein, and insulin. Mixed together, the materials selfassemble into tiny, insulin-loaded particles.

Put into a glucose solution, the particles partially dissolved, releasing some insulin. Coinvestigator Todd Zion attributes this to a competition between sugar molecules in dextran and the glucose in the solution to bind with the protein molecules. When the concentration of glucose in solution decreased, the particles stopped releasing insulin.

"Only the surface peels away with each cycle" of glucose exposure, says Zion. When injected under the skin, the particles are expected to store and release enough Materials Research Society Fall Meeting December 1 – 5, Boston, Mass.

M E E T I N G S

insulin for 2.5 days, the researchers say. Because the particles respond quickly to changes in glucose concentrations, diabetic people could presumably achieve tighter control over their blood sugar with the new particles than with multiple daily insulin injections.

Zion and his colleagues have successfully tested a version of the drug-release system in diabetic rats. The team has launched a company called SmartCells to commercialize the technology. —A.G.

# New materials take the heat

Silicon is the workhorse material for solar cells, but some researchers have been developing inorganic nanoparticles combined with dye molecules as a potentially cheaper alternative. However, high temperatures and prolonged exposure to light can wreck these materials, making them impractical for outdoor applications such as solar panels. A research group led by Michael Grätzel at the Swiss Federal Institute of Technology in Lausanne claims it has found a way to stabilize these dye-sensitized materials.

In the new scheme, the solar cell consists of a pair of electrodes sandwiching a thin film of titanium oxide nanoparticles bound to dye molecules, all surrounded by a polymer gel. When light shines on the solar cell, the dye molecules absorb the light and transfer electrons to the titanium particles. The particles carry the electrons to one of the electrodes, generating a current. Ions in the polymer gel replenish the dye molecules with electrons.

To prevent the dye molecules from detaching from the titanium particles—a major cause of instability—the researchers chemically modified the dyes to make them more hydrophobic. This reduced the dye molecules' solubility in the polymer gel, preventing them from removing themselves from the metal particles.

In stability tests, the new solar cell proved just as hardy as standard silicon solar cells. Grätzel says that this development could foster the widespread deployment of lower-cost solar cells. -A.G

## Books

A selection of new and notable books of scientific interest

#### 8 PREPOSTEROUS PROPOSITIONS: From the Genetics of Homosexuality to the Benefits of Global Warming ROBERT EHRLICH

In a follow-up to *Nine Crazy Ideas in Science*, physics professor Ehrlich continues to explore the science



behind some ideas that may seem dubious. This time, he takes up issues that are controversial enough to "offend just about everyone." Instructing readers on how to evaluate data, he strips the politics from debates ranging from medical matters to global warming. In the process, he assesses which ideas have scien-

tific merit and which don't. A "flakiness rating" is assigned to each idea. Among the topics covered are the placebo effect, the supposed myth of cholesterol, whether people are getting smarter or dumber, and intelligent design as an alternative to evolution. *Princeton U Pr, 2003, 342 p., b&w photos/illus., hardcover, \$27.95.* 

#### A CENTURY OF INNOVATION: Twenty Engineering Achievements That Transformed Our Lives

GEORGE CONSTABLE AND BOB SOMERVILLE During the past 100 years, society has been transformed by the efforts and magnificent accomplishments of engineers. The National Academy of Engineering celebrates feats such as electricity, the automobile, radio, television, and computers in this oversized, brilliantly illustrated retrospective. From



the first flight by the Wright brothers at Kitty Hawk to the birth of the Internet, readers learn the story behind each great achievement and the impact these things have on our lives today. For example, the harnessing of electricity facilitated 10 or so other accomplishments on this list

and spurred economic development of both farm communities and cities across the United States. The section devoted to this topic discusses various methods for generating electricity and illustrates how electricity is distributed. Diagrams appear throughout the book, as do time lines tracking development of each engineering achievement discussed. *Joseph Henry Pr, 2003, 248 p., color/b&w photos/illus., hardcover, \$45.00.* 

#### GALILEO IN ROME: The Rise and Fall of a Troublesome Genius

WILLIAM R. SHEA AND MARIANO ARTIGAS Almost everyone is familiar with the 1633 Inquisition in Rome of Galileo, during which the Catholic Church condemned him for teaching that Earth is in motion and revolves around the sun. Shea and Artigas look beyond that event to reveal that Galileo made six long visits to Rome during his lifetime to meet with high-ranking members of the Church, as well as leading scientific and literary figures, in an effort to become known and accepted. The authors focus on Galileo's thinking and stage of life during each of these journeys. Shea and Artigas are both noted scholars on the subject of Galileo. Shea holds the Galileo Chair at the University of Padua in Italy, and Artigas, a professor of philosophy at the Univer-



sity of Navarra in Spain, is also an ordained priest with a background in physics. Their interpretation of the Inquisition is much more sympathetic to the Church than many others have been. The Church's arguments

are clearly defined, and the authors show how Galileo's personality and approach got him

into hostile situations long before 1633. Jealousy and contempt on both sides of his relationships with the Romans came to a head and played a key role in his trial and sentencing to prison. *OUP*, 2003, 226 p., b&w plates, hardcover, \$28.00.

#### HOW TO KEEP DINOSAURS ROBERT MASH

This tongue-in-cheek guide is an entertaining and informative look at how dinosaurs lived. Geared toward older children, *How to Keep Dinosaurs*, is written as a pet-owner's manual, but in this case, the pets are dinosaurs. Profiles of these prehistoric creatures detail what they eat, how big they get, where they're available, what temperatures they prefer, how to house them,



details of their breeding, and what to watch out for in each one's disposition. Mash is a noted zoologist and lifelong dinosaur enthusiast who has a lot of fun speculating what it would be like to have a *stegoceras*, which

is touted as a "friendly and inoffensive pet," or an *anurognathus, which* is "ideal for the pond-owner who wants something more original than ornamental waterfowl." Not all featured dinosaurs are so friendly. The entry for *tyrannosaurus* encourages acquisition of insurance and caging of all viewing points to prevent "spectacular homicides." Recommended for age 12 and up. Originally published in the United Kingdom. *Weidenfeld & Nicolson,* 2003, 96 p., color illus., hardcover, \$14.99.

#### TROPICAL FLOWERING PLANTS: A Guide to Identification and Cultivation

KIRSTEN ALBRECHT LLAMAS With the scholarship of a botany textbook and the beauty and how-to advice of a fine gardening book, this encyclopedia catalogs a wide variety of plants that thrive in Florida, the Gulf Coast, California, and Hawaii, as well as in greenhouses everywhere. More than 1,400 flowering trees, shrubs, vines, and herbaceous plants commonly grown in gardens with an



annual low temperature of at least 20°F are detailed in these pages. The volume is arranged alphabetically by family, each described in an introduction. Individual species entries then detail scientific and common names, origins, range for hardy growth, dormancy habits,

blooming season, flower and leaf descriptions, details of where to procure the plant, and requirements for moisture, soil, and sun. A color photograph displays each specimen. *Timber, 2003, 423 p., color photos/illus., hardcover, \$69.95.* 

**HOW TO ORDER** To order these books, please contact your favorite bookstore. *Science News* regrets that at this time it can't provide books by mail.

### LETTERS

#### **Significant issue**

It is quite sad that your otherwise-excellent publication systematically fails to report error bars in your reports. Time and again I read articles and am left wondering whether the effect reported is even statistically significant. As just one example, "Treatment helps newborns avoid HIV" (*SN: 10/25/03, p. 270*) said that the rate of subsequent infection from breast milk dropped from 12 percent to 8 percent. Given the numbers in each sample, it is quite likely that the difference reported is simply due to chance. **KEVIN LEHMANN**,

PRINCETON UNIVERSITY, PRINCETON, N.J.

The results cited in the story were significant at a probability greater than 95 percent. As a general rule, for the sake of readability, Science News doesn't include statistics on the significance of data. Readers should rest assured, however, that we don't report results if a statistical test has failed to find them significant. —THE EDITORS

#### No dark secret

In 1993, Israeli physicist Moti Milgrom showed an adjustment to the way gravity is calculated that would make dark matter go away in Newton's system for calculating gravity. If Milgrom's math were used in the survey for dark matter in "Cosmic Survey: Galaxy map reveals dark business as usual" (*SN: 11/1/03, p. 275*), would it also make dark matter go away?

O. FRANK TURNER, WESTMINSTER COLO.

Most astrophysicists would say they still see the need for dark matter in the universe. —R. COWEN

#### Six-foot-deep symbolism

A simpler explanation for ancient humans' use of red ocher might be cosmetics, much as in modern mortuary practice ("Stone Age Code Red: Scarlet symbols emerge in Israeli cave," *SN*: 11/1/03, p. 277). A dusting of red ocher would offset the blue pallor that results when blood flow ceases. No deep, dark symbolism was necessarily involved. **VIRGIL H. SOULE,** FREDERICK, MD.

Any mortuary practice involves symbolism. Simply burying a person's body instead of leaving it where it lies invokes symbolic thinking. —B. BOWER

**Correction** A name was misspelled in "Tiny Bubbles" (SN: 12/6/03, p. 363). The University of Michigan cancer researcher mentioned at the top of the story is Gustavo R. Rosania.

## CROSSWORD PUZZLE

# **SCIENCE NEWS CHALLENGE**

Every word required for this puzzle appeared in a *Science News* article during 2003. If you need a hint, check the article by going to the volume and page number listed after each clue.



#### Across

- 2. Water repelling (163: 356)
- 8. Smog generator (*163: 166*)
- 9. Sound rebound (*163: 252*)
- 11. Arctic terrain computer model (163: 314)
- 13. Einstein's domain (*163: 190*)
- 14. Higher-dimensional orb (163: 378)
- 16. Toxic flame retardant slated for phaseout (*164: 266*)
- 17. Sperm producers (163: 334)
- 18. Frictionless flow (164: 262)

- 19. Circuitry exploiting electron spins (163: 118)
- 23. Sticky stuff (163: 356)
- 25. Result of thinning hair (163: 403)
- 27. Ocean predators (163: 68)
- 29. Waxy rocket fuel (163: 187)
- 30. Skilled stone workers (163: 235)
- 33. Congo virus (164: 83)
- 34. Resp. infection from China (163: 198)
- 35. No backbone but a great navigator (163: 4)
- 36. Radioactive elements (164: 265)
- 37. Bottom-feeding fish (*163: 132*)

#### Down

- 1. Literally, ear stones (163: 333)
- 3. High blood pressure (163: 19)
- 4. Sugar source (164: 29)
- 5. Transgene-escape crop (164: 233)
- 6. Defenders in blood (*164: 54*)
- Aliens running amok in New Orleans (164: 344)
- If chilled in youth, dancing suffers (163: 324)
- 12. Hairs on gecko's sticky soles (163: 356)
- 15. Breaking waves (*164: 198*)
- 20. Five-unit subatomic particle (164: 3)
- 21. Detergent target (163: 292)
- 22. Tree nearly wiped out by fungus (163: 282)
- 24. Gene-influenced reading disorder (164: 131)
- 26. Places for crops (163: 85)
- 28. Toxic metal found in poultry (164: 259)
- 31. Memories rest on it (164: 228)
- 32. Bird that may count eggs before they hatch (163: 212)

Answers are available online at http://www.sciencenews.org/ puzzle\_answers.asp and will be printed in the Jan. 3, 2004 issue of *Science News.* 



THE WEEKLY NEWSMAGAZINE OF SCIENCE

### **Fighting off the viruses**

A couple decades ago, if someone had asked whether you'd heard about "that new virus," you'd have known that they were concerned about a health threat. This year, you'd have needed to ask, "Medical or computer?" On both viral fronts, 2003 was eventful. A new viral disease emerged in China, and travelers spread it around the globe. A series of novel viruses and other cyberpathogens swept the Internet and invaded computers worldwide, doing more damage than anything like them had done before.

*Science News* reported more progress against the biological viruses than against the computer versions, as scientists identified and characterized the virus for severe acute respiratory syndrome (SARS), made progress on vaccines for Ebola virus and rotavirus, and developed more drugs against HIV. In fact, some computer scientists looked to biology for strategies to vanquish their foes.

Here at *Science News*, we've experienced both kinds of virus this year. One writer was recently bedridden for a week by the nasty flu that's spreading throughout the country. And our Web site has suffered from a variety of invaders. We're pleased to report that both the writer and the site have returned to health.

Over the past 8 years, the online version of *Science News* (www.sciencenews.org) has grown in popularity. Besides making available articles from our printed magazine, it offers two unique weekly series. Janet Raloff writes about food and nutrition in "Food for Thought," and Ivars Peterson contributes items of general mathematical interest in his "MathTrek" forays.

And now there's even more. This year saw the launch of *Science News for Kids* (www.sciencenewsforkids.org), which is devoted to making science news accessible to young people. The site provides a weekly helping of timely articles of interest to middle school students, along with puzzles, games, science fiction ideas, hands-on activities, links to Web resources, and material for teachers and parents.

Because our Web content has become so valuable, we are for the first time including highlights of it in "Science News of the Year." Take a peek on pages 409 and 410, then fire up your Web browsers for a firsthand look!

-Julie Ann Miller, Editor and Ivars Peterson, Online Editor

HOW TO OBTAIN FULL ARTICLES This review lists important science stories of 2003 reported in the pages of SCIENCE NEWS. The reference after each item gives the volume and page number on which the main article on the subject appeared (vol. 163 is January–June; vol. 164 is July–December). An asterisk indicates that the text of the item is available free on SCIENCE NEWS ONLINE (http://www.sciencenews.org). Full text of any article can be obtained for \$2.50 from ProQuest (http://pqasb.pqarchiver.com/sciencenews). Back issues are available for \$3 each (prepaid). Send orders to SCIENCE NEWS, 1719 N Street, N.W., Washington, D.C. 20036.

#### Anthropology & Archaeology

**Human roots** The discoverers of 160,000year-old *Homo sapiens* skulls in Ethiopia said that their finds underscore humanity's evolution in Africa independently of Neandertals (*163: 371\**).



Genetic material extracted from the bones of prehistoric European *Homo sapiens*, or Cro-Magnons, fueled the controversial theory that people and Neandertals didn't interbreed (*163: 307\**).



Lumps of colorful ochre at an Israeli cave led investigators to conclude that symbolic thinking occurred at least 90,000 years ago (*164: 277\**). Complex thought probably arose much earlier, contended a researcher who explores Stone Age nautical abilities (*164: 248\**).

**Primate gene** Scientists identified a hybrid gene that, in their view, contributed to the evolution of apes and people (*163: 115*).

**Island growers** Evidence of banana cultivation in New Guinea nearly 7,000 years ago indicated that agricultural practices spread from there to Southeast Asia (*163: 389\**).

**First Americans** A DNA study suggested that people first reached the Americas fewer

\* An asterisk indicates that the text of the item is available free on SCIENCE NEWS ONLINE (http://www.sciencenews.org).

### SCIENCE NEWS Of the year

than 20,000 years ago ( $164:84^*$ ). A skeletal comparison indicated that America's first settlers left direct descendants who lived in Mexico as recently as 600 years ago ( $164:150^*$ ).

**Got milk** Chemical analyses of 6,000-yearold pot fragments found in England indicated that the vessels once held milk, providing the earliest uncontested evidence of dairying (*163: 67\**).

**Silver starters** After analyzing soil at a Bolivian lake, researchers concluded that silver production in the region began 1,000 years ago, long before the Incas made silver (*164: 198*).

#### Astronomy

**Shuttle tragedy** The space shuttle Columbia disintegrated minutes before it was scheduled to land on Feb. 1 (*163: 83\**). All seven of its crew members died. Tests revealed that the shuttle had been doomed since liftoff, when a piece of loose insulation punctured a hole in its left wing (*163: 308; 164: 21*). NASA's plan to return space shuttles to flight next year came under intense scrutiny (*164: 203\**). Researchers are working on more heat-tolerant materials and designs for vehicles that might ultimately replace the shuttle (*163: 215\**).

**Dark doings** Astronomers found new evidence that a mysterious substance, dubbed dark energy, is ripping the cosmos apart, causing the universe to expand at an everfaster rate (*164: 67\*, 227\**). The most precise map of galaxy clusters confirmed that most of the cosmos is in the dark, consisting of 70 percent dark energy, 25 percent dark matter, and 5 percent ordinary matter (*164: 275*).

**Precocious cosmos** A new portrait of the infant cosmos pinned down its age with unprecedented precision, providing new evidence that the universe began with a brief but humongous growth spurt and that the cosmos already contained a plethora of stars when it was just 200 million years old (*163: 99\**). Other evidence indicated that massive galaxies were in place and forming stars at a prolific rate when the universe was less than a billion years old (*163; 51, 139\**).

#### **ALL ABOUT MARS**

Planetary scientists discovered ice near the edge of Mars' south polar cap (163: 45). Melting snow may have sculpted the recently formed gullies on Mars (163: 116\*). The presence of large amounts of the mineral olivine argued against ancient oceans or lakes on Mars (164: 301). Scientists deduced that the Red Planet's core is at least partially liquid (163: 221). Mars came closer to Earth than it had in nearly 60,000 years (164: 148).

**Alien planets** Astronomers found a planet that's the closest one known to its parent star, whipping around the star every 28.5 hours (*163: 301*). Scientists also discovered the oldest and most distant known planet in the universe (*164: 19\**). A star 90 light-years from Earth harbors the closest known multiplanetary analog to our solar system (*164: 174*).

**Galactic clash** A tiny, newly discovered galaxy being shredded by the gravity of the Milky Way is our galaxy's closest known neighbor (*164: 307*).



Using a gravitational zoom lens, scientists found the hottest, brightest, and most crowded star-forming region yet observed (*164: 291*).



The sharpest images of the sun ever taken showed surprising details of our star's turbulent surface (*163: 404\**).



**Strange rain** Thousands of alien stars are raining down on the solar neighborhood (*164: 382*).

**Violent neighbor** The most detailed visible-light picture ever taken of the heavens revealed that the nearby Andromeda galaxy has had a much more violent history than our own Milky Way has had (*163: 291\**).

**Holey mass** Astronomers measured the mass of the most-distant black hole known (*163: 317*).

**Farewell, Galileo** Out of fuel, the Galileo spacecraft followed NASA's plan and ended an 8-year tour of Jupiter and its moons on Sept. 21, when it dove into the planet's dense atmosphere (*164: 196*).

**Splish splash** Using radar-based observations, planetary scientists obtained the best evidence yet that Saturn's smog-shrouded moon Titan has lakes or oceans of hydrocarbons (*164: 213*).

**Neptune summer** Belying its location in the deep freeze of the outer solar system, Neptune may undergo a change of seasons (*163: 325*).

**Lost and found** Astronomers reported that they had finally found the whereabouts of most of the ordinary matter in the universe (*163: 174*). Other researchers rediscovered an asteroid that had been missing since 1937 (*164: 277\**).

**Infrared debut** Astronomers unveiled the first images and spectra recorded by an orbiting infrared observatory, the newly named Spitzer Space Telescope (164: 387\*).

**Warmer, fluffier Pluto** Although Pluto has been receding from the sun for more than a decade, its atmosphere recently doubled in size and its temperature increased by about 1°C (*164: 126*).

**Explosive data** Gamma ray bursts may be even more energetic than scientists had estimated (*163: 180*). Astronomers uncovered direct evidence that gamma ray bursts are linked to the creation of supernovas (*163: 317*).

**Cosmic blowout** Supermassive black holes at the cores of galaxies can blow out as much material as they swallow, creating high-speed winds that seed the universe with elements essential for life (*163: 214\**).

**Sound from a hole** Astronomers for the first time detected sound waves generated by a black hole (*164: 163\**).

#### Behavior

**Bad read** Scientists identified the first gene that appears to foster the development of dyslexia (*164: 131\**).

**Memory clues** Experiments suggested that a common biological mechanism boosts memories of emotional events and blocks recall of what happened just before those events (*164: 293\**). Other trials showed that memories of learned skills must be stored and then restored, with the aid of a night's sleep (*164: 228\**).

**Psychotic ties** Alterations of genes implicated in producing a protective covering for brain cells were linked to psychotic symptoms in both schizophrenia and bipolar disorder (*164: 164*).

**IQ shifts** A new analysis found that periodic revisions of IQ tests dramatically alter the number of students classified in



#### ADHD BRAINS

An imaging study indicated that disturbances in a network of brain regions that participate in control of attention and behavior underlie attention-deficit hyperactivity disorder in kids and teens (164: 339\*).



Monkeys demonstrated to scientists for the first time that a nonhuman species harbors a sense of fairness (164: 181\*).

U.S. schools as being mentally retarded (164:  $259^*$ ). Other researchers probed the biology of intelligence (163: 92) and the environment's effect on IQ scores (163: 293).

**Fatal slumber** Sleep difficulties were linked to higher-than-normal death rates from natural causes among healthy elderly people (*163: 85\**).

**Child welfare** A three-state study indicated that welfare-to-work programs for poor mothers don't harm the emotional health and academic skills of their children (*163: 149*).

**Money matters** A financial windfall for Native American families provided evidence that poverty undermines psychological health (*164: 244\**). Other studies suggested that strongly materialistic values lessen people's sense of happiness and well-being (*164: 152*).

**Social survival** Older people who frequently help their spouses, friends, and others showed a survival advantage over seniors who don't (*164: 51\**). Scientists also reported that a potentially dangerous change in the immune system occurs in many elderly people who care for their incapacitated spouses (*164: 5\**).

#### Biomedicine

**Hormone quandary** Elderly women taking estrogen and synthetic progesterone are more likely to have strokes and develop Alzheimer's disease than are women not taking the hormones (*163: 341*). However, a drug related to progesterone helps some women extend their pregnancies (*163:*  *371*), and ultralow doses of estrogen and progesterone boost bone density in postmenopausal women without producing adverse effects (*164: 133*).

**Shooting SARS** An epidemic dubbed severe acute respiratory syndrome, or SARS, developed in China and spread around the globe. Scientists quickly identified the responsible virus, deciphered its genes, and determined how it infects cells (*163: 198, 262\*; 164: 341\**).

**Take heart** A technique that employs bone marrow cells to rebuild heart tissues showed early success (*164: 323\**). Mesh cylinders called stents, used to prop open coronary arteries, work better when coated with a drug that inhibits the accumulation of cells (*164: 214*).

**Allergy advance** Researchers successfully demonstrated the first preventive drug treatment against peanut allergy (*163: 163\**).

**Unseen risk** An enzyme in the bloodclotting process appeared to explain heart attacks in some Viagra users (*163: 38\**).

**Vexing vaccine** A federal smallpoxvaccination campaign stumbled, in part over concerns that the vaccine's risks might outweigh the benefit of better bioterrorism preparedness (*163: 218*). Other research showed that people vaccinated decades ago may retain protection against smallpox (*163: 340*).

**Better shots** Vaccines advanced. An experimental vaccine built immunity against Ebola in monkeys (*164: 83\**); a new tuberculosis vaccine excelled in animal tests (*163: 318*); a vaccine against rotavirus advanced (*164: 204*); and an experimental anthrax vaccine appeared to stop the anthrax bacterium and disable its toxin at the same time (*164: 147*).

**Anemia cure** Using stem cell transplants and a compound called anti-thymocyte globulin, researchers in Paris cured 59 of 69 children of sickle-cell disease (*163: 29*).

**Diabetes data** Diabetes patients who adhered to a strict program of blood sugar control over 7 years showed long-term heart benefits (*164: 14*). Researchers found that one form of an immune system gene shows up frequently in people with diabetes or certain thyroid diseases (*163: 278*) and that the age at which infants first eat cereal may affect their risk of developing diabetes (*164: 212*).

# the vear

Gene gains Scientists tracked down disease-causing mutant genes, including those responsible for some cases of atrial fibrillation, autism and early-aging syndrome (163: 21, 212, 260).

Good news Giving drugs to babies born to HIV-positive mothers made the infants less likely to contract the virus through breastfeeding (164: 270). Three experimental AIDS drugs performed well in early tests (163: 117\*). A harmless virus that seems to keep HIV infections from progressing to AIDS appeared to occupy key molecular receptors on immune cells (163: 173).

Bad news The first large test of an AIDS vaccine failed to shield an at-risk population (163:133), and a combination of drugs that researchers anticipated would work well against HIV failed to stop the virus reliably (164:222).

Renewed immunity A thymus-tissue transplant enabled babies that were born with DiGeorge's syndrome to develop functional immune systems (164: 69).

Pain pill A protein that heals injured nerve cells thwarted various forms of chronic pain in animals (164: 245).

Aging well Having extralarge cholesterol particles in the blood may promote longevity, according to a study of very old people (164: 243).

Blood check Donated blood and organs should be screened to prevent transmission of West Nile virus, federal officials said (163: 253).

Testing testosterone After reviewing recent studies on the benefits and risks of treating age-related symptoms with testosterone, a medical panel expressed concern over widespread use of the unproven therapy (163: 296\*; 164: 382).

Reading cancers Advances in magnetic resonance imaging profiling genes' activities showed promise in helping physicians identify aggressive prostate tumors (164:123\*).

Cancer fighters Baldness drug finasteride showed hints that it could prevent some cases of prostate cancer (163: 403), and a

#### WHOLE-BODY SCANS DEBATED

Doctors are divided on whether the value of screening the torso with X rays to find symptomless disease outweighs the costs. Though the scans' imaging of lungs turns up plenty of worrisome spots signifying possible cancers, most of those spots ultimately prove harmless. Scans focusing on the heart and administered to people at somewhat elevated risk of cardiovascular disease are generally considered beneficial (164:184\*).

potential AIDS drug slowed the growth of brain tumor cells in lab studies (164: 260\*). Two cancer vaccines fashioned from proteins showed promise (163: 13, 398).

Kindest cut Research confirmed that surgery to remove diseased portions of the upper lungs helps some emphysema patients breathe better (163: 323\*).

Pregnancy woes A placental protein was linked to preeclampsia symptoms, and the finding may improve detection and treatment of the disease (163: 147\*). Other research suggested that a natural compound called asymmetric dimethylarginine plays a role in preeclampsia (163: 293). Also, a study showed that pregnant women taking nonprescription painkillers, such as ibuprofen and aspirin, had an elevated risk of miscarriage (164: 115\*).

Gut reaction Given as a drug, a protein fragment called epidermal growth factor induced remission of ulcerative colitis (164:51).

A new class of experimental drugs that mimic the actions of the hormone glucagon-like peptide 1 showed benefits against type 2, or adult-onset, diabetes. The drugs are based on a compound first identified in the saliva of the venomous Gila monster (Heloderma suspectum). Glucagon-like peptide 1 revs up and refurbishes insulin-making cells of the pancreas and might spawn the growth of new cells (164: 104).

No scope A CT scan worked as well as colonoscopy in detecting signs of colon cancer (164: 355\*).

Early warning The amount of calcium in the coronary arteries and the compound adiponectin both showed promise as markers of heart disease in seemingly healthy people (164: 174, 334). And women who lose one or more fetuses during early pregnancies proved to be about 50 percent more likely than other women to later suffer heart disease (163: 157).

Liver protection A new drug prevented the replication of the hepatitis C virus (164: 276), while gene therapy that induces infected liver cells to self-destruct dramatically slowed hepatitis C in mice (163: 349).

Alzheimer's update The drug memantine slowed the progression of late-stage Alzheimer's disease (163: 211). In a lab dish, the cancer drug imatinib mesylate, also called Gleevec, reduced formation of the kinds of plaques found in Alzheimer's patients (164: 285). Spinal-fluid concentrations of two compounds linked to Alzheimer's showed promise as a test of whether a person has the disease (164:179).

Questionable supplement The compound ephedra provides only modest weight-loss effects and poses health risks, an analysis of research showed (163: 237). Another study found that the weight-loss supplement Metabolife 356, which contains ephedra, can cause subtle changes in a person's heartbeat (164: 334).

Brain gain Bathing dopamine-making neurons with a natural protein that induces nerve-fiber growth reversed some of the symptoms of Parkinson's disease (163: 245). Inhibiting the protein cyclo-oxygenase-2 also emerged as a possible way to fight Parkinson's (163: 285).

Sour dreams Children who snore frequently were more likely to struggle with their schoolwork than were children who rarely snore (164: 173\*). Sleep apnea, a breathing disorder that often accompanies  $\ge$ 







snoring, perhaps explained why President William Howard Taft frequently dozed off (*164: 238*).

**Short supply** People lacking a full complement of blood-filtering nephrons in their kidneys at birth were found to be at increased risk of high blood pressure (*163: 19\**).

**Fat chance** Research mounted that fatderived acids called ketones could help treat a variety of disorders involving abnormal cellular metabolism (*164: 376*).

#### **Botany & Zoology**

**Enforcer beans** In a novel study of partnerships between species, researchers found that soybeans punish root-dwelling microbes that don't fulfill their obligation (*164: 221*).

**First impressions** In a new wrinkle on how females develop mate preferences, female wolf spiders chose males whose courtship shows resembled displays they had seen when young (*164: 276*).

**Daddy diligence** Bluegill sunfish provided a tidy confirmation of the prediction that a dad's diligence in child care depends on how certain he is that the offspring are really his (*163: 246*).

**Splitsville** Genetics bolstered the idea that musical taste, rather than geography, split Africa's indigobirds into multiple species (*164: 116*). And because a Japanese snail with a shell spiraling to the right can't mate readily with a lefty, scientists concluded that changes in the single gene that controls shell direction created a new species (*164: 243*).

**Fig-wasp upset** Within what had been a textbook example of a tight buddy system—fig species that supposedly each has its own pollinating wasp—some species team up with multiple partners (*163: 259*).

**Wren spots killers** For the first time, researchers found a bird species—Australia's superb fairy-wren—in which the female often deserts the nest if her own chicks disappear and a giant imposter, a young cuckoo, takes their place (*163: 206*).

**Bird smarts** New Caledonian crows were shown to ratchet up the sophistication of their technology by sharing design improvements—perhaps the first display of this capability outside of people (*163: 182\**). Female coots appeared to tally their eggs in nests, a rare example of an animal counting in the wild (*163: 212*).



Entomologists decided that stick insects might have done something once thought impossible: lost a complicated trait, their wings, in the course of evolution but recovered it millions of years later (*163: 35*).

**Sex specific** After more than a decade of work, an international team found the main gene that separates the girls from the boys among honeybees (*164: 132*).

**Homing lobsters** Spiny lobsters became the first animals without backbones to pass tests for the orienteering power called true navigation (*163: 4*).

**Incubate or bust** Bird eggs can catch infections through their shells, and parent birds start incubating their eggs as soon as possible to reduce that risk (*164: 189*).

**Chain links** New data supported a hypothesis about a mysterious spike in neurological disease in Guam: The food chain—bacteria to plants to bats to people— magnifies the tissue concentrations of a naturally produced neurotoxin (*163: 310; 164: 366*).

#### Cell & Molecular Biology

**Steroid shocker** Invertebrates have proteins that respond to estrogen and other steroids, indicating that this hormonal system evolved earlier than previous data had indicated (*164: 180*).

**Finding phages** Microbiologists discovered that bacteriophages, the viruses that invade bacteria, have incredible genetic diversity and abound in oceans and soils (*164: 26\**).

**Cell conversion** Controversial studies suggested that cells in bone marrow or the blood can become a diverse array of cells, including those of the brain or liver (*163: 54, 131\**). Cells grown from mouse embryos can transform into eggs or almost any other kind of cell (*163: 349*).

**Khan's legacy** A genetic survey indicated that about 1 in every 12 men in Asia and 1 in 200 worldwide, harbors a form of the Y chromosome tied to Genghis Khan or the men of his armies (*163: 91*).

**Sperm science** Studies suggested that animal sperm follow temperature gradients and odors as they seek eggs (*163: 69, 195*) and that sperm quality deteriorates as men age (*163: 222*).

**Blood work** Platelets, generally considered simple clotting agents, were found to guide an animal's complex immune responses (*164: 54*).

**Fashion bug** A controversial study of the genetics of different lice forms indicated that people first wore clothing about 72,000 years ago (*164: 118\**).

**Dog DNA** Geneticists deciphered much of a poodle's DNA sequence, enabling scientists to compare it with human and mouse DNA (*164: 197\**).

**Eye-opening debate** While genetic studies revealed that the sense of smell declined in primates as they evolved better color vision, scientists continued to debate whether primates originally depended on that vision for spotting red leaves or ripe fruit against a leafy green background (*164: 234*).



Scientists cloned a horse and a mule for the first time, and Dolly the sheep, the first cloned animal, died (*163: 141; 164: 83\**).

**Hear here** Scientists showed that it's possible to regrow the sound-sensitive cells within the mammalian inner ear (*163: 355\**).

**Right decision** Scientists proposed that an electric field inside an embryo tells it whether to place internal organs to the left or right (*164: 187*).

Feline finding The discovery of the gene mutations that produce black cats

### SCIENCE NEWS Of the year

prompted discussion of whether the widespread mutations once protected felines from an infection (*163: 147\**).

#### Chemistry

**No assembly required** Using DNA as a scaffold, researchers devised a way of creating carbon-nanotube transistors that self-assemble in a test tube—a feat that paves the way for more-complex circuits made from these nanocomponents (*164: 324*).

**Bone fix** To serve as a scaffolding for the formation of new bone, a polymer material was adorned with proteins that stimulate bone regeneration and others that lead to the dismantling of the scaffolding as new bone tissue grows (*163: 261\**).

**Unnatural origins** Bacteria and yeast cells were genetically engineered to incorporate an unnatural amino acid into their proteins, an advance that may lead to new drugs and shed light on the origin of the genetic code (*163: 53; 164: 102*).

**Gecko tape** Modeling the sticking properties of a gecko's sole, researchers created an adhesive material that consists of arrays of microscopic plastic pegs (*163: 356\**).

**Miniature motor** A gold plate centered on the shaft of a multiwalled carbon nanotube rotated when a voltage was applied, yielding a molecular-scale motor only 300 nanometers long (*164: 54*).



**SUPERHYDROPHOBICITY** From polymers and carbon nanotubes, scientists fabricated self-cleaning materials dubbed superhydrophobic because water easily rolls off them and carries away dirt (*163: 132\*; 164: 278*).

#### UNDERWATER BALANCING ACT

Microscopic crystals of aragonite located in the inner ears of zebrafish control balance and hearing. During development, special proteins guide the assembly of these crystals, called otoliths. When researchers dampened the activity of a gene that codes for one of these proteins, the otoliths switched from smooth round (top) to starshaped (right) aragonite crystals. Silencing the gene entirely yielded chunky calcite crystals (bottom). Fish with modified otoliths became disorientated and swam in circles (*164: 301*).

**Perfect timing** A biodegradable polymer microchip implanted under the skin could store and deliver multiple doses of medications at programmed intervals, eliminating the need for pills and injections (*164: 260\**).

**Danger detection** In the wake of the Sept. 11, 2001 attacks, analytical chemists raced to develop portable sensors capable of detecting the barest whiff of a chemical or biological weapon (*163: 362*).

**Plastic memories** In pursuit of cheaper materials for permanently storing vast amounts of digital data, researchers fabricated a memory device out of electrically conducting plastic (*164: 309*).

**Refueling rockets** Experiments showed that paraffin wax might someday replace solid fuel in shuttle booster rockets, possibly becoming the cheapest, safest, and most environmentally friendly rocket fuel (*163: 187\**).

**Anemia begone** A synthetic—and potentially more effective—version of the protein erythropoietin for treating anemia generated more red blood cells and lasted longer in the bloodstream than its natural counterpart does (*163: 109*).

**Super threads** Fibers made from carbon nanotubes mixed with an industrial polymer were 20 times as tough as steel wire and 17 times as tough as the Kevlar used in bulletproof vests (*163: 372\**).

#### Earth Science

**Clearing the air** Chemical analyses of Earth's lower atmosphere showed that the overall concentration of bromine, a component of some potent ozone-destroying chemicals, has dropped by 5 percent since peaking in 1998 (*164: 118*).



**Slow turnover** Over the past 90 years, rising water temperatures in Africa's Lake Tanganyika have led to dramatic losses of productivity among the microorganisms that form the base of the lake's food chain ( $163: 404^*$ ).

**The fire below** In Mali, hot swaths of ground punctuated by smoking, potholelike features are evidence not of volcanic activity but of a layer of peat that is burning 2 feet below the desert surface (*164: 22*).

**Ebbing floods** A new analysis of historical flood records from central Europe suggested that widespread inundations in that region have been on the wane for the past century or so (*164: 166*).

**Saltier water** A decrease in precipitation over the Pacific Ocean north of Hawaii in recent years has left the ocean there saltier and has diminished its capacity to soak up carbon dioxide (*164: 101*).

**Tree pollution** Northern pine forests may exude nitrogen oxides—gases that contribute to smog and acid rain—in quantities that rival those produced by industry and traffic worldwide (*163: 166\**).

**Sensing a vibe** Scientists suggested that the network of seismometers that covers the Los Angeles area could be adapted to warn of earthquakes in the seconds before their vibes arrive (*163: 276\**).

**Northern vents** An undersea survey along a midocean ridge beneath the Arctic ice pack unveiled an unexpected abundance of hydrothermal activity (*163: 37*).

**Protective blanket** A new computer model suggested that Earth's thin atmosphere is an unexpectedly good shield against small asteroids (*164: 36*).

**Going down?** A geophysicist suggested that scientists could explore Earth's inner structure by sending a grapefruit-size probe to the planet's core inside a crust-boring mass of molten iron (*163: 307\**).

**By grace** Global gravity maps compiled from data gathered by the twin GRACE satellites in preliminary tests have rendered old maps obsolete (*163: 6\**).

**Slippin' slides** The flow of five of the six large glaciers that once fed into Antarctica's Larsen A ice shelf has sped up significantly since that floating ice mass collapsed and drifted away in January 1995 (*163: 149*).

**Smothering smoke** The fires that swept through Indonesian rain forests late in 1997 seemed to have laid waste to some of the region's marine ecosystems (*164: 158*).

**Rivers run to it** Increasing fresh water discharges into the Arctic Ocean could disrupt patterns of deepwater ocean circulation that affect climate (*163: 29*).

**Magnetic breakthrough** Satellites that happened to be in the right places at the right time confirmed that proton auroral spots high in the atmosphere result from solar wind gushing through a rupture in Earth's magnetic field and showed that the breach lasts for hours (*163: 381; 164: 372*).

**Magnetic whirtwinds** Field studies showed that dust devils can produce a small magnetic field that changes magnitude between 3 and 30 times per second (*163: 94*).

**Frosty Florida** Land-use changes associated with planting crops in southern Florida



**BRANDON; R. CAULDWEL** 

Analyses of minerals called zircons in Utah sandstones suggested that much of the material in several thick layers originated in the Appalachians (*164: 131*). may have slightly increased the risk of the freezes that farmers hoped to avoid when they originally moved there (*164: 292*).

#### Environment & Ecology

**Drinking safely** New low-cost, at-home treatments for microbe-contaminated drinking water could save millions of lives in developing countries (*163: 136, 403\**).

**Air sickness** Studies of outwardly healthy people showed harmful effects from their regularly breathing hazy air (*164: 72\**).

**Toxics treaty** Countries must reduce or eliminate the production and use of 16 persistent pollutants, under a United Nations treaty that went into effect (*164: 301*).



#### **ECOBULLIES**

U.S. scientists are looking for means to contain invasive environmental threats, including tiny greenhouse frogs, nonnative garden plants, and Asian termites (163: 11\*, 232\*; 164: 344\*).

**Puberty hang-up** Even low concentrations of lead in a girl's body may delay her reproductive maturation (*163: 408*).

**Flaming out** After studies linked a ubiquitous family of flame retardants to toxic effects in animals (*164: 266\*, 269*), the U.S. manufacturer of one of the chemicals volunteered to phase out its production next year (*164: 275\*, 294*).

**Nonstick risks** A pollutant shed by nonstick coatings and surfactants was shown to kill birds and rats and impair development in rodents (*163: 355; 164: 142*).

**Quicksilver skies** Certain pollutants can foster the localized fallout of mercury, a toxic heavy metal ( $163: 72^*$ ).

**Fished out** In less than a generation, modern industrial-scale fishing can exhaust the edible bounty of a plot of ocean (*164: 59\**). **Wrong number** The primary chemical in some plastics caused female mice to produce eggs with abnormal numbers of chromosomes (*163: 213*).

**Count down** Scientists linked reduced fertility in men with exposure to chemicals called phthalates, but not the phthalates anticipated to cause problems (*163: 339\**).

**Choke hold** Oxygen deprivation altered sex hormones in carp and it might underlie declines in some other fresh-water fish and amphibians (*163: 132*).

**Cottoning to Bt** Yields from small farms in India and industrial fields in Arizona showed the bright side of genetically engineered cotton (*163: 85\**).

**Night shift** Women who had worked at least a few nights a month for many years appeared to face an increased risk of colorectal cancer (*164: 13*).

**Mixed results** Tests of genes that might escape from sunflowers engineered to resist white mold found little probable impact on wild plants, but similar tests with sunflowers that make Bt pesticide predicted a significant impact (*164: 232\**).

**Cleaned out** Trace amounts of the chemicals used to battle bacteria in kitchens and bathrooms may kill off algae in streams, with potentially far-reaching consequences, studies found (*163: 196\**).

### Food Science & Nutrition

**Medicinal purposes** A nip of alcohol can be therapeutic, but usually not until middle age (*163: 155, 157*).

**Fractious vitamin** People consuming large amounts of vitamin A in foods or supplements appeared more likely to suffer hip fractures than were people who ingested more-modest amounts of the vitamin (*163: 52\**).

**Food soothies** Chronic stress might drive people to consume comfort foods because excess abdominal fat can soothe the brain (*164: 165\**).

**Brain food** As little as one serving of fish per month offered some protection against the most common form of stroke (*163: 46*).

**Soy clues** A compound from soybeans that have been damaged or stressed interfered



with estrogen activity, suggesting new breast-cancer drugs (*164: 302*).

**Cowed not** As Canadian health officials investigated a domestic case of mad cow disease, researchers were working on the next generation of defenses against the brain disease in animals and people (*163: 340\**).

**Supplementary risks** In animal tests, an herbal extract called black cohash that some women use to relieve symptoms of menopause increased the likelihood that breast cancer cells would spread (*164: 62*).



Many herbal-product makers aren't maintaining quality control, prompting the Food and Drug Administration to propose rules that mandate good manufacturing practices for the industry (*163: 359\**).

**Cancer threat diminished** A study found it unlikely that people develop cancer from eating foods containing acrylamide, a building block of many plastics (*163: 84*).

### Mathematics & Computers

**Disguised spheres** A Russian mathematician offered a proof of the Poincaré conjecture, a question about the shapes of three-dimensional spaces, but it remained unclear whether the proof is solid (*163: 259, 378\**).

**Ideal justice** A mathematical analysis suggested that the current U.S. Supreme Court of nine judges behaves as if it were made up of 4.68 "ideal" justices who always make their decisions independently (*163: 405\**).

**Small world** A large-scale study of e-mail users supported the notion that one person on the planet can reach any other person through a chain of about six social ties (*164: 103\**).

**Shape of space** The debate over the shape of space took some new twists with the mathematical analysis of satellite snapshots of the universe's temperature waves (*164: 296*).

**Digital cells** Researchers geared up to engineer cells with computer programs hard-wired into DNA (*163: 267\**).

**Knotty calculations** An alternative approach to quantum computing took advantage of space-time knots and braids (*163: 124\**).

**Infinite wisdom** A mathematician proposed a new approach to resolving a longstanding question about infinite sets of numbers (*164: 139*).

**Best guess** Economists explored the use of betting markets as tools for predicting the consequences of policy decisions by a government, a corporation, or another institution (*164: 251\**).

**Eye contact** New software and hardware for implementing attentive systems showed promise in improving human-computer interactions (*163: 279\**).

#### Paleobiology

**Fertile ground** Sediment samples from New Zealand and Siberia yielded bits of DNA from dozens of animals and plants. Some 400,000-year-old snippets were traced to a specific plant species (*163:* 244\*).

**Three species no moa?** Analyses of genetic material from fossils of large, flightless birds called moas suggested that three types of the extinct creatures may not have been separate species after all (*164: 84*).

**Daytime travelers** The wide brims that some ancient trilobites grew over their eyes strongly suggested that at least some species of the aquatic creatures were active during the daytime nearly 400 million years ago (*164: 221*).

**Family meal** Analyses of the gnaw marks on bones of *Majungatholus atopus*, a carnivorous dinosaur, indicated that the creatures routinely fed on members of their own species (*163: 211\**).



Imagine guinea pigs the size of a bison. Scientists did just that when they analyzed the fossilized remains of the world's largest known rodents, which browsed on the riverbanks of Venezuela about 8 million years ago. The front and rear limbs of a nearly complete skeleton suggest that the 740-kilogram creature rested on its haunches and manipulated food with its front paws (*164: 179\**).

**Special dung** Researchers extracted DNA from cells preserved in the desiccated dung of an extinct ground sloth. Analysis of the genetic material may identify the creature as a new species (*164: 19*).

**Gummy web** A look inside a piece of 130-million-year-old amber revealed a thin filament of spider silk with sticky droplets that look just like those produced by modern spiders (*164: 141*).

**Winging south** A tiny fossil collected about 500 kilometers from the South Pole indicates that Antarctica was once home to a type of fly that scientists previously thought had never inhabited the now-icy, almost insectfree continent ( $163: 292^*$ ).

#### Physics

**Gimme five!** New finds forced theorists to reexamine models of interaction among fundamental particles called quarks. Previously found only in twos or threes, quarks turned up in possible four- and five-particle groupings at several accelerator laboratories (*164: 3\*, 245\*, 381*). New evidence also turned up for unexpectedly light quark combinations (*163: 333*).

**Supermolecules** Physicists induced clouds of trapped, ultracold molecules to form Bose-Einstein condensates. This state of matter, in which all particles are in the same

2003 YearEnd 12/17/03 14:44 Page 409

quantum state, had been achieved only with atoms (164: 324\*).

**Matter's momma?** An analysis of particle collisions inside an accelerator strengthened indications that those impacts briefly recreated a fiery soup of matter that permeated the universe just after the Big Bang and then condensed into the bulk of subatomic particles known today (*163: 387\**).

**Ups and downs** Landmark particle-accelerator experiments provided physicists with long-sought data needed to better understand up and down quarks, the building blocks of ordinary matter (*163: 227\**).



Scientists probing the origins of superfluidity, or frictionfree flow, found that an accumulation of just seven atoms of liquid helium appears sufficient to trigger that exotic state (*164: 262*).

**One-atom laser** Sandwiched between mirrors and stimulated by intense light, a single, ultracold cesium atom let loose its own infrared laser beam, which was the most orderly beam of laser light ever produced (*164: 181\**).

**Doppler toppler** After 60 years of anticipation, experimenters finally created an inverse Doppler effect, an increase in the frequency of an electromagnetic wave, rather than the usually observed decrease in frequency, from a receding source (*164: 358*).

**Spin doctored** Using electrical signals to manipulate a magnetic property of electrons known as spin, researchers took a major step toward a new type of spin-based electronics and, possibly, toward computers that exploit the strangeness of quantum mechanics to do calculations (*163: 118*).

**Humpty-dumpty** The first measurements of how people's bodies scatter sound waves indicated that, acoustically, a human body resembles an elongated chicken egg (*164: 308\**).

**Crack stoppers** Recognizing that cracks stretch rather than propagate in some rubbery solids, researchers developed a new theory of failure resistance for stretchy materials such as skin and adhesives (*163: 261*).

**Molecular command** A technique that triggers specific vibrations in individual molecules enabled scientists to sever selected bonds in those particles and to make some molecules slide along a surface or pop free of it (*163: 339*).

**Warm, slow light** By dramatically slowing laser pulses in a room-temperature ruby, researchers brightened prospects that slow-moving or even stopped light may attain practical use in optical communications or other applications (*163: 252*).

#### Technology

**Performing paper** New types of liquidbased pixels that can rapidly change color may ultimately serve as building blocks for full-color video images on flexible electronic paper (*164: 195\**).

**Cereal-box lasers** Refinements to a polymer-imprinting technique enabled researchers to create little plastic lasers, which may be a step toward dirt cheap laser-based sensors and communications gadgets (*164: 53\**).

**Hocus focus** The advent of unconventional lenses that first garble images to ultimately make them better for computer processing has led to finer-focused images than traditional lenses can offer and to extraordinarily efficient new ways to extract information, such as enemy troop movements, from optical data (*163: 200\**).



A simple method of interleaving ultrathin layers of positively and negatively charged materials yielded novel coatings for uses ranging from food preservation to energy production (164: 91\*).



**SQUISHY CERAMIC** Titanium silicon carbide, a little-studied ceramic, was found to spring back fully from intense compression rather than to shatter, as most ceramics do (*163: 141*).

**Tailored titanium** Theory-based calculations replaced trial and error in the development of titanium-based alloys that have many qualities far superior to those of previously known alloys (*163: 243\**).

**Keep on truckin'** In a potential boon to automated management of crowded highway networks, a new method of tracking trucks with in-road sensors turned out to be an exceptionally fast way to detect the onset of traffic jams (*163: 150\**).

### SCIENCE NEWS ONLINE Food for Thought

**See no peanut** Some baby lotions and creams can trigger immune reactions in infants that result in serious food allergies months later (*www.sciencenews.org/* 20030315/food.asp).

**Chipped beef** Engineers have developed sophisticated wireless monitoring packages to relay health and geographic data from livestock out in the pasture (*www.science news.org/20031004/food.asp*).

**Eyes wide shut** When blindfolded, obese volunteers ate one-quarter less food—with no loss in satisfaction (*www.science news.org/20030208/food.asp*).

**C-minus** In children, exposure to even a little secondhand smoke significantly depressed concentrations of vitamin C (*www.sciencenews.org*/20030118/food.asp).

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Spying eyes The use of satellites to monitor the planting and any spread of genetically engineered crops showed promise (www.sci encenews.org/20030830/food.asp).

Forget-me-not diet A nutritious dietary supplement appeared to prevent middleage forgetfulness-at least in rats (www.sci encenews.org/20031122/food.asp).

#### MathTrek

Prime record A computer search turned up the 40th Mersenne prime. It's a 6,320,430digit behemoth that now holds the record as the largest known prime number (www.sci encenews.org/20031206/mathtrek.asp).

Faulty randomness Researchers provided new mathematical insight into why certain random-number generators give wrong results in some computational experiments and simulations (www.sciencenews.org/ 20030927/mathtrek.asp).

Even larger The Goldbach conjectureevery even number larger than 2 is the sum

of two prime numbers-has been verified up to 6 x 10<sup>16</sup> (www.sciencenews.org/ 20031011/mathtrek.asp).

Shape superformula A new, simple equation generates a wide variety of appealing and biologically relevant shapes (www.sci encenews.org/20030503/mathtrek.asp).

**Election reversal** In votes involving three or more candidates, many election procedures can produce the same result when voter preferences are reversed (www.science news.org/20031018/mathtrek.asp).



Electronic paper Changeable ink and battery-powered paper could eventually make textbooks lighter and bring video newspapers into daily use (www.science newsforkids.org/articles/20031203/Fea ture1.asp).

Dinosaur growth Learning how fast dinosaurs grew may clarify their link with

birds (www.sciencenewsforkids.org/arti cles/20031126/Feature1.asp).

Defying gravity A gecko's remarkable grip on walls and ceilings suggests new types of sticky materials (www.science newsforkids.org/articles/20031119/ Feature1.asp).

Virtual reality Computer technology that puts kids in a cartoon classroom may help children with attention disorders learn to pay attention (www.sciencenewsforkids.org/ articles/20031022/Feature1.asp).

Counting crows Animals that can count or find quick routes to a goal have taught scientists a thing or two about how to handle numbers (www.science newsforkids.org/articles/20031008/ Feature1.asp).

**Venom delivery** Poisonous snakes appear to control the amount of venom that they inject into their victims (www.science newsforkids.org/articles/20030903/ Feature1.asp).

Sky dust Dust raining down from space and Earth's atmosphere provides information about weather patterns, pollution, and the origin of the universe (www.science newsforkids.org/articles/20030813/ Feature1.asp).

INDEX ABBOTT, MARK B. - ASAMI, TAKAHIRO

Aircraft

### Science News Index

Vol. 164, Nos. 1-26, July-December 2003, pp. 1-416

A DECEMBER OF	
Abbott, Mark B 198	
Abbott, Nicholas L	
Abram, Nerilie J 158	
Acetaminophen 115, 292	
Acetylsalicylic acid 115	
Acoustics	
Actuators	
Adiponectin	
Adolescents. See also Puberty	
Aerodynamics	
Aging	
Agre, Peter 229, 246	
Agriculture 5, 24, 292, 317, 372	
Aguirre, Gustavo D 197	
AIDS 222, 270, 347, 363	
Air pollution	

٨

And an
Aizenberg, Joanna 190
Alaska
Alexander, Albert W 58
Alexander, R. McNeill 390
Alkanes 254
Alkyl nitrates
Allergies
Alley, Richard B
Alligators
Alpha particles
Alroy, John
ALS
Altruism
Alzheimer's disease 68, 72,
Amalthea
Amber 141
Amboseli National Park 42

125 136

American Indians . ... 84 Americas, early civilizations 198 Americas, human occupation. .... 84, 150, 212 Amino acids ..... 102, 157 Amnesia . 293 Amphetamine ..... 221 Amphibians ..... 302 Amyloid protein ..... 179 Amyotrophic lateral sclerosis Analgesics. 99 Anderson, Paul C. ..... 276 Angioplasty . . 214 Angiotensin-converting-341 enzyme 2 Animals, captivity ..... 211

Anions
Antarctica
Anthrax
Antibiotics
Antibiotics, resistance to
Antidepressants
Antimatter
Antioxidants 164
Antiquarks
Ants
Appalachians 131
Aquaculture 308
Do you use the printed index stories, or do you search the

Aquaporins	
Archaeology	
Arctic Muon and Neutrino	
Detector Array II 109	
Armand, Jean-Pierre 62	
Arnaud, Jean-François 29	
Arnold, Elizabeth	
Arsenic	
Art	
Artemieva, Natalia A 37	
Artemin 245	
Artificial intolliganca 124	

Asami, Takahiro. . . . .

find past Science New editors@sciencenews.org or a note to Science News 1719 N Street NW, Washington, DC 20036. Thank you

243

#### **INDEX** ASBESTOS – DEPRESSION

Asbestos       21, 142         Asia       333         Aspirin       115         Asteroids       36, 277         Asthma       72, 117, 318	Beta amyloid	Bu Bu Bu Bu
Astrocytes	Bildsten, Lars	
Astrup, Arne	Biogeochemistry 315	C-t
Atherosclerosis 243, 334	Biological control 344	Ca
Athletes	Biological diversity 85, 102	Са
Atkinson, Mark 213	Biometics	Ca
Atomic physics See Particle	Bioremediation 150	Ca
physics	Bipolar disorder 164	Ca
Attention	Birds 29, 37, 78, 116, 189	
Attention deficit disorder . 339	Birnbaum, Linda S 266, 275	Ca
Australian Aborigines 150	Birtri defects	Ca
Authorship attribution 392	Bjedov, Ivana	Ca
AZT 270	Black cohosh 62	Са
B	Black holes 40, 109, 132,	60
	Blackhodies 218	Ca
	Blake, Donald R 254	Ca
Baboons	Bland, Philip	Са
Bacteria	Blazer, Dan	Са
	Blindness	Ca
Badgers	Blood pressure 373	Ca
Bahcall, John N	Blood sugar	Ca
Bahn, Sabine 164	Blumstein, Dan 201	Са
Baker, Daniel	Bobe, Rene	Ca
Baker, Michael	Boltzmann equation 68	Ca
Banack, Sandra	Bond, John H	Ca
Banfield, Jill 315, 316	Bones 133, 221	
Bangham, Charles 196	Bone marrow	Ca
Bangsberg, David R 149 Par Vosof, Ofor 11	Bonow, Robert O	Ca
Barkay Tamar 150	Bose-Finstein condensation	Ca
Barnes, Graeme 205		Ca
Barnes, Peter D	Bosons 324	Са
Baron, Alain D 108	Boss, Alan P 19, 329	Са
Barry Dave 24	Boughn Steven 67	CA
Barry, Roger G	Bourne, John	Ca
Bartel, David P	Bowmaker, James 235	Ca
Barton, M. Kathy	Bradshaw, Emily G 94	Ca
Barzlial, Nir	Brain	Ca
Basu, Asish R	Brain anatomy	Ce
Bates, David73	Brain, imaging 30, 339	Се
Bats	Brain, neural networks 165	Ce
Batteries	Brand-Miller, Jennie 269 Brant Zawadzki Michael 185	Ce
Baughman, Ray	Braun, Erez	Ce
Baumgardner, Darrel	Brazil nuts	Ch
Bawden, Thomas M 316	Breastfeeding 266, 270	Ch
Bearer, Elaine L	Breathing	Ch
Beasley Michael A 99	Bromage Tim 250	Ch
Becerra, Judith X	Bromine	Ch
Beckett, William S 21	Brooks, Rodney 136	
Bednarik, Robert G 248	Brosnan, Sarah	Ch
Beetles 318	Brown Stanley 7	Ch
Beets	Brown, Stephanie L 51	Ch
Begue, Rodolfo E 204	Brown, Susan	Ch
Beheregaray, Luciano B 211	Brownlee, Donald E 116	Ch
Benrensmeyer, Anna K 42 Belcher Angela	Brune Harald 172	Ch
Bell, Dan	Brvan, Teresa	Ch
Bell, James F 61, 299	Bryant, Donald A 101	Ch
Bell, Michelle L	Bshary, Redouan	Ch
Bennett, Charles	Buckminster fullerenes93	Ch
Bercovici, David 174	Buildings	Ch
Bereavement 189, 398	Bullock, Morris 158	Ch
Bergman, Ake 268, 275	Bulovic, Vladimir	Ch
Bering Sea	Burke, John 233	Ch
Bernstein, Garv M 148	Burns, Joseph A 328	Ch
Bertotti, Bruno 238, 281	Burns, Mark	Ch

yloid 68	Burton, Harry
s 104	Bushman, David M 318
Sel 134	Butterflies 210
artin 133	Butternies
Lars	С
Roger	
nemistry 315	C-reactive protein 366, 373
al control	Cadmium
al diversity 85, 102	Canili, Larry
S 69	Calcito 147
diation 150	Calcium 174 221
lisorder	Calderón-Garcidueñas, Lillian
29, 37, 78, 116, 189	
n, Linda S 266, 275	Calorie restriction 75
ects 266	Campbell, Donald B 214
Ruth 205	Campion, Scott 44
vana	Canas, Alberto
10S11	Calicel 30, 38, 105, 333, 254, 242, 271, 291
155 163	Cancer brain 260, 350
lies 218	Cancer, breast 62, 302, 349
onald R	Cancer, colon 13, 62, 355
nilip	Cancer, kidney
an	Cancer, lung 142, 164, 184
s	Cancer, prostate 123, 253
ots	Cannabinoids
essure	Cannibalism
gar	Caporaso, Nell
III, DdII	Carbon 26 197
imer Peter 270	Carbon dioxide 101 206 286
nn equation 68	Carbonates
hn H	Cardiac arrest See Heart
	disease
irrow	Carmeliet, Peter 22
Robert O	Carmichael, Howard 181
my M	Carrington, James C 311
stein condensation	Cartilage
	Casarolla William I 184
an P 19.329	Cassini mission 213 238
ephen M	
Steven	CAT scans
John	Catalysts 45, 158
er, James 235	Catenanes 93, 182
<i>w</i> , Emily G 94	Cattle
	Cave art
	Collular automata 106
atomy	Cellular phones 142
ural networks 165	Cereals
iller, Jennie 269	Cerebral palsy
wadzki, Michael 185	Cesari, Matteo
rez	Cesium 181
ts	Chakrabarty, Deepto 125
eding 266, 270	Chambers, Janice E 310
8	Chambles, John E 174 Chambles, Timothy N
Tim 250	Chance Wendy 275
	Chandra X-ray Observatory
Rodney 136	
, Sarah	Chaos
ester R 60	Charge-parity violation 189
stanley7	Chase, Charles
Stephanie L 51	Chatman, Jennifer A 154
Donald F 116	Chatterton, Brian 221 Chaudhuri, Swadoo K
er Martina 100	Chaudhury Manoi K 200
arald 170	Chazine, Jean-Michael 148
eresa	Chemokines
Donald A 101	Chen, Hudong
Redouan 78	Chen, Kay-Yut
ster fullerenes 93	Chen, Wilfred 150
Natthew 185	Chen, Xuemei
5	Chesley, Steven
WUTTS	Child dovelopment
nauimi	158 244
athleen	Children
seph A	Chin, Jason W 103

С	
reactive protein 366, 373 idmium	
10rie restriction       73         Impbell, Donald B.       214         Impion, Scott       44         Innas, Alberto.       137         Incer       36, 38, 165, 333,	
disease Irmeliet, Peter	
NT scans       184, 355         italysts       45, 158         itenanes       93, 182         ittle       24         ive art.       147         vigelli, Sonia A.       373         ilular automata       106	
Ilular phones         142           greals         212           grebral palsy         339           seari, Matteo         366           silum         181           nakrabarty, Deepto         125	
aambers, Janice E.       310         nambers, John E.       174         namblee, Timothy N.       260         nance, Wendy       275         nandra X-ray Observatory	
narge-parity violation 189 nase, Charles 365 natman, Jennifer A 154 natterton, Brian 221 naudhuri, Swades K 270 naudhury, Manoj K 390	
hazine, Jean-Michael       148         hemokines       260         hen, Hudong       68         hen, Kay-Yut       252         hen, Wilfred       150         hen, Xuemei       314         hensley, Steven       277	
ickens	

Chinnaivan Arul	
Shininaiyan, Arui	124
Chirals	157
Chisholm, Sallie	100
Chiorpyritos	309
Chodas Paul	209
Choi leongsoo	285
Cholera	293
Cholesterol 126, 243,	334
Christensen, Philip R	
	301
Chronic obstructive pulmo	nary
disease	11/
Shung Androw	73
Churg, Anurew	298
Cigarettes	. 14
Cilia	187
Ciochon, Russell L	250
Circadian rhythms	350
Cirrus clouds	356
Clack, Jenniter A	173
Jancey, William J	137
lark, n. rieu	204
Clark, Valerie	149
Clarke, Kieran	376
Clay, Jason	390
Clay, Keith	374
Clays	285
Cleary, Patricia A.	. 14
Climate 13, 101,	237
204 215 202	210
Climate global temperatu	1310 re
	356
Cloning 83,	237
Clothing	118
Clouds	388
Nubb Doc	211
JUDD, RUS	211
Cluster spacecraft.	372
Cluster spacecraft	372 . 91
Cluster spacecraft Coatings Coen, Enrico	372 . 91 314 125
Cluster spacecraft Coatings Coen, Enrico Cognition	372 . 91 314 . 125 . 357
Cluster spacecraft. Coatings Coen, Enrico Cognition 101, Cognitive therapy Cohen, Lizabeth	372 . 91 314 . 125 . 357 153
Cluster spacecraft. Coatings Coen, Enrico Cognition	372 .91 314 .125 .357 .153 .347
Cluster spacecraft. Coatings Coen, Enrico Cognition	372 .91 314 .125 .357 .153 .347 .52
Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cohe, Peter.	372 .91 314 125 357 153 .347 .52 .24
Cluster spacecraft. Coatings Coen, Enrico Cognition 101, Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Coll, Alison	372 .91 314 125 357 153 347 .52 .24 .51
Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cola, Mark Coll, Alison Cole, Peter. Collitis	211 372 .91 314 125 357 153 347 .52 .24 .51 389
Cluster spacecraft. Coatings Coen, Enrico Cognition	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 249
Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Collard, Mark. Collistis Collard, Mark. Colletti, Lisa. Collon polyos	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 269 355
Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Coli, Alison Collard, Mark Collard, Mark Colletti, Lisa Collons, James J. Colonopolyps Colonoscopy	211 372 .91 125 357 153 347 .52 .24 .51 389 292 269 355 355
Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collitis Collard, Mark. Colletti, Lisa Collons, James J. Colon polyps Color blindness	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 269 355 355 234
Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cole, Mardge H. Coli, Alison Cole, Peter Collitis Collard, Mark. Colletti, Lisa Colletti, Lisa Collon polyps Colon polyps Colon scopy Color blindness Columbia space shuttle.	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 269 355 355 234 .21,
Cluster spacecraft. Coatings Coen, Enrico Cognition 101, Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Coli, Alison Cole, Peter. Collitis Collard, Mark. Colletti, Lisa. Collard, Mark. Colletti, Lisa. Collons, James J. Colon polyps Colonoscopy Color blindness. Columbia space shuttle. 203,	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 269 355 355 234 .21, 371
Cluster spacecraft. Coatings Coen, Enrico Cognition	211 372 .91 314 125 357 153 347 .52 .24 .51 389 292 269 355 355 234 .21, 371 .22
Cluster spacecraft. Coatings Coen, Enrico Cognition	2 11 3 72 . 91 314 125 357 153 347 . 52 . 24 . 51 389 292 269 355 355 355 355 355 355 355 35
Cluster spacecraft. Coatings Coen, Enrico Cognition	2 11 3 72 3 72 3 72 3 72 3 72 3 72 3 71 3 72 3 71 3 72 3 71 3 72 3 71 2 72 3 71 2 72 3 71 2 72 3 71 3 72 3 74 3 75 3 75
Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colliss Collard, Mark. Colletti, Lisa. Colletti, Lisa. Collon polyps Colon polyps Colon polyps Color blindness. Color blindness. Columbia space shuttle. Compact disks Compact disks Complexity Composite materials.	2 1 1 3 72 . 91 314 125 357 153 347 . 52 . 24 . 51 389 292 269 355 234 . 21, 371 . 22 148 . 13 106 . 69
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Cole, Peter. Collists Collard, Mark. Colletti, Lisa. Collon polyps Colon polyps Colon blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Combustion. Compact disks Compact disks Composite materials. Composite materials. Computed tomography.	2 1 1 2 1 2 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 74 3 57 3 55 3 55 3 55 3 55 3 55 3 55 3 71 3 71 3 71 3 72 1 48 . 13 1 06 . 22 1 48 . 69 2 29
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collist Collard, Mark. Collist Collard, Mark. Collist Colletti, Lisa Collins, James J. Colon polyps Colon polyps Color blindness Color blindness Color blindness Color blindness Combustion. Combustion. Compact disks Complexity Composite materials. Computed tomography. Computer monitors	2 1 9 3 72 . 91 314 125 357 153 347 . 52 . 24 . 51 389 292 269 355 234 . 21, . 371 . 22 148 . 13 106 . 69 229 195
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collist Collard, Mark. Collist Colletti, Lisa Collins, James J. Colonoscopy Color blindness Colonoscopy Color blindness Colonoscopy Color blindness Combustion. Compact disks Complexity Composite materials. Computer tomography. Computer networks	2 17 2 . 91 314 125 357 153 347 . 52 . 24 . 51 389 292 269 355 355 234 . 21, 371 . 22 148 . 13 106 . 69 229 195 103
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collitis Collard, Mark. Collitis Collitis Collard, Mark. Collitis Colletti, Lisa Collins, James J. Colletti, Lisa Collonscopy Colon polyps Colon scopy Color blindness Colonoscopy Color blindness Combustion Compact disks Complexity Composite materials. Computer tomography Computer networks Computer simulations	2 11 3 72 3 72
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Mardge H. Cole, Mardge H. Cole, Mardge H. Cole, Mardge H. Cole, Mardge H. Cole, Mards Cole, Mards Collard, Mark. Collard, Mark. Colletti, Lisa. Collard, Mark. Colletti, Lisa. Collon polyps Colon polyps Colon polyps Colonoscopy Color blindness. Colonoscopy Color blindness. Colonoscopy Color blindness. Colonoscopy Color blindness. Colonoscopy Color blindness. Colonotoscopy Color blindness. Computed tomography. Computer monitors Computer simulations Computer simulations Computer liceholas L	2 11 3.72 3.72 3.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 355 234 .21, 371 .22 .48 .13 106 .69 229 195 103 .68 181 289
Cluster spacecraft. Coatings Coen, Enrico Cognition	2 11 2 17 3 72 . 91 314 125 357 153 347 . 52 . 24 . 51 389 292 269 355 355 234 . 21, 371 . 22 148 . 371 . 69 299 195 . 68 181 389 292 103 . 68 181 389 115 . 68 181 389 115 . 68 181 389 115 . 68 181 389 115 . 68 181 389 185 . 68 181 385 . 68 181 . 68 181 . 68 181 . 68 181 . 68 181 . 68 181 . 68 181 . 68 181 . 68 181 . 68 . 7 . 7 . 7 . 7 . 7 . 7 . 7 . 7
Cluster spacecraft. Cluster spacecraft. Coenings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Coil, James J. Colle, Peter. Collard, Mark. Collard, Mark. Collard, Mark. Collard, Mark. Collard, Mark. Collard, Mark. Collard, Mark. Collon polyps Colon polyps Colon oscopy Color blindness. Colon polyps Colonoscopy Color blindness. Colon blindness. Colon blindness. Color blindness. Colonostory Color blindness. Colonostory Color blindness. Colonostory Color blindness. Colonostory Computer simulations. Computer networks. Computer simulations. Computer simulations. Connet, Nicholas J. Conception	211 217 217 217 217 217 217 217
Cluster spacecraft. Cluster spacecraft. Coenings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Coli, Peter. Colitis Collard, Mark. Colletti, Lisa. Collard, Mark. Colletti, Lisa. Collins, James J. Colon polyps Colon polyps Colon polyps Color blindness. Color blindness. Computer space shuttle. Computer monitors Computer monitors Computer simulations Computers, quantum Conard, Nicholas J. Conduct disorder Connor, Richard C.	211 217 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, 371 .22 148 .371 .22 148 .371 .69 229 195 .68 181 389 115 244 .22 .48 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .51 .22 .24 .21 .22 .24 .21 .22 .24 .21 .22 .24 .21 .22 .24 .21 .22 .24 .21 .22 .24 .22 .24 .21 .22 .24 .22 .24 .22 .24 .22 .24 .22 .24 .22 .24 .22 .24 .22 .22
Cluster spacecraft. Cluster spacecraft. Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Colliss Collard, Mark. Collitis Collard, Mark. Collists Collor polyps Colon polyps Colon blindness Color blindness Compact disks Compact disks Computer materials. Computer networks Computer networks Computer simulations Computer s, quantum Conard, Nicholas J. Connor, Richard C. Consciousness	211 217 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, 371 .22 148 .13 106 .69 229 195 103 .68 181 389 115 244 284 109
Cluster spacecraft. Cluster spacecraft. Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collits Collard, Mark. Collits, James J. Colletti, Lisa Collon polyps Colon polyps Color blindness Color blindness Color blindness Color blindness Color blindness Color blindness Color blindness Color blindness Computs space shuttle. Compact disks Complexity Computer monitors Computer networks Computer networks Computer simulations Computer simulations Computers, quantum Conard, Nicholas J. Consciousness Conservation 33	211 217 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, 371 .22 148 .13 106 .69 229 195 103 .68 181 389 115 244 284 109 7, 85
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collist Collard, Mark. Collist Collard, Mark. Collist Colletti, Lisa Collins, James J. Colonoscopy Color blindness Colonoscopy Color blindness Color blindness Colonoscopy Color blindness Compustion Combustion. Compact disks Complexity Computer monitors Computer networks Computer simulations Computer simulations Computer simulations Connets Connets Connets Connet simulations Consciousness Conservation Construction Construction Construction Construction	2 11 3 72 3 73 3 75 3 89 2 92 2 69 3 55 2 34 . 2 2 . 2 4 . 3 71 . 2 2 1 48 . 13 106 . 69 2 29 103 . 68 181 3 89 115 2 44 2 84 109 7, 85 . 93 . 91 . 95 . 93 . 91 . 93 . 91 . 91 . 93 . 93 . 91 . 93 . 94 . 95 . 93 . 94 . 95 . 95
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognition Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collist Collist Collard, Mark. Collist Colletti, Lisa Collins, James J. Colonoscopy Color blindness Colonoscopy Color blindness Colonoscopy Color blindness Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Conduct disorder Consciousness Construction Conting Stephane G. Conting Stephane G.	2 11 3 72 3 72 1 73 1 73 1 73 1 75 2 74 1 73 1 75 1 73 1 75 2 74 1 73 1 75 2 74 1 73 1 75 2 74 1 73 1 75 2 74 1 75 2 74 2 75 3 73 3 75 3 75
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Lizabeth Cohen, Mardge H. Cole, Peter. Colitis Collitis Collitis Collitis Collitis Collitis Collitis Collitis Collitis Collitis Collitis Collitis Colling, James J. Collitis Collonscopy Color blindness Colonoscopy Color blindness Colonoscopy Color blindness Colonoscopy Color blindness Colonoscopy Color blindness Computes space shuttle. Compact disks Complexity Composite materials. Computer disks Computer disks Computer simulations Connert simulations Connert simulations Connert clisorder Conncr, Richard C. Consciousness Construction Conti, Stephane G. Continuum hypothesis Continuum hypothesis	2 11 3 72 3 74 3 55 3 89 2 92 2 69 3 55 3 234 . 21, 3 71 . 22 1 48 . 13 106 . 69 2 29 195 . 103 . 68 181 3 89 2 292 2 69 3 55 2 34 . 21, 3 71 . 22 148 . 13 106 . 69 2 29 195 . 103 . 68 181 3 89 2 92 2 69 3 55 2 34 . 21, 3 71 . 22 148 . 13 106 . 68 181 3 89 2 92 2 69 3 55 2 34 . 21, 3 71 . 22 148 . 13 106 . 68 181 3 89 2 92 2 93 . 55 . 234 . 13 106 . 68 181 3 89 2 92 . 24 . 13 . 105 . 68 181 3 89 2 92 . 24 . 103 . 68 181 3 89 2 92 . 24 . 103 . 68 181 3 89 2 92 . 103 . 68 181 3 89 2 92 . 103 . 68 181 3 89 2 94 . 103 . 68 181 3 89 2 94 . 103 . 68 181 3 89 . 93 3 08 139 152 . 152 . 152 . 152 . 153 . 153 . 68 . 153 . 69 . 93 . 308 139 . 152 . 152 . 152 . 152 . 153 . 153 . 68 . 153 . 68 . 153 . 69 . 308 . 152 . 152 . 152 . 152 . 153 . 155 . 155
Cluster spacecraft. Cluster spacecraft. Coatings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Coil, Jaison Coile, Peter. Coilitis Collard, Mark. Collerd, Jaise, Jaise, Collerd, Co	2 11 2 172 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 74 3 55 3 347 . 52 3 89 2 92 2 69 3 55 3 355 3 347 . 52 3 89 2 92 2 69 3 55 3 355 3 308 1393 142 3 308 3 308
Cluster spacecraft. Cluster spacecraft. Coenings Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colliss Collard, Mark. Colletti, Lisa. Collings, James J. Collon polyps Colon polyps Colon polyps Colon polyps Color blindness. Collor blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Compact disks Compact disks Computer materials. Computer monitors Computer networks. Computer simulations Computer simulations Consciousness Consciousness Consciousness Construction Conti, Stephane G. Conke, Mark I. Cooke, Mark I.	2 11 2 172 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 72 3 74 3 57 3 55 3 55 3 55 3 55 3 71 3 71 3 72 1 48 3 69 2 29 1 95 3 68 1 81 3 89 1 15 3 68 1 81 3 89 1 15 3 68 1 81 3 89 1 15 3 68 1 81 3 89 1 15 3 68 1 81 3 89 1 55 3 74 2 24 1 69 2 29 1 95 3 68 1 81 3 89 1 55 3 74 2 44 2 84 1 09 7, 85 3 78 1 37 1 32 2 44 2 84 1 39 1 55 3 74 2 74
Cluster spacecraft. Cluster spacecraft. Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colliss Colliss Collard, Mark. Colliss Collard, Mark. Collins, James J. Colon polyps Colon blindness Color blindness Compact disks Compact disks Computer materials. Computer materials. Computer simulations Computer simulations Computer simulations Consciousness Consciousness Consciousness Consciousness Construction Conti, Stephane G. Continuum hypothesis Cooke, Mark I. Cooks, Mark I. Cooks, Reraham	211 217 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 148 .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .24 .21, .371 .22 .23 .229 .239 .229 .229 .229 .239 .229 .229 .229 .235 .229 .229 .229 .238 .229 .238 .229 .238 .229 .238 .229 .239 .229 .239 .229 .239 .229 .239 .229 .239 .229 .239 .229 .239 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .229 .238 .239 .229 .238 .229 .238 .238 .229 .238 .238 .229 .238 .238 .229 .338 .688 .339 .284 .284 .09 .93 .308 .399 .53 .224 .284 .139 .53 .224 .53 .224 .53 .53 .53 .224 .53 .53 .53 .53 .53 .53 .55 .53 .53
Cluster spacecraft. Cluster spacecraft. Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Collisis Collard, Mark. Collisis Collard, Mark. Collisis Collor polyps Colon polyps Colon blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Color blindness. Compact disks Compact disks Computer monitors Computer networks. Computer simulations Computer simulations Computer simulations Connets. Connets. Consciousness. Conservation. Conti, Stephane G. Conti, Stephane G. Contin, Unicholas J. Conti, Stephane G. Contin, Stephane G. Consciousness. Cooks, Rark I. Cooks, Mark I.	211 2172 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, 371 .22 148 .371 106 .229 195 103 .69 229 195 103 .68 181 389 115 .93 .94 .21, .22 .24 .24 .21, .24 .24 .24 .24 .24 .24 .24 .24
Cluster spacecraft. Cluster spacecraft. Coen, Enrico Cognitive therapy Cohen, Lizabeth Cohen, Lizabeth Cohen, Mardge H. Cohen, Mardge H. Cole, Peter. Colitis Collard, Mark. Collits Collard, Mark. Collits Collard, Mark. Collits Collard, Mark. Collits Collard, Mark. Collits Collard, Mark. Collits Collard, Mark. Collits Collor blindness Colonoscopy. Color blindness Color blindness Compact disks Complexity Computer monitors Computer networks Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Computer simulations Continuum hypothesis Consciousness Construction Continuum hypothesis Cook, Philip M. Cooke, Rark I. Cooper, Alan Copper	211 2172 2.91 314 125 357 153 347 .52 .24 .51 389 292 269 355 234 .21, 371 .22 148 .13 106 .69 229 195 103 .68 181 389 115 244 284 109 7, 85 .93 308 139 153 142 153 153 153 153 153 153 153 153

		344
	Corals 158,	198
	Cords, Marina	283
	Cornish, Neil	297
	Coronal mass ejections	355
	Cortisol	165
	Cosmic microwave	
	background	. 67
	Cosmic rays	109
	Cosmology	296
	Costello, E. Jane 157,	245
,	Counting skills	308
	Covey, Richard O	203
	Cows	. 24
	Cox, Paul Alan	366
	Crampton, James S	. 43
	Craters	5, 93
	Crawley, Mick J	233
	Creatine	101
	Crews, David	181
	Criss, Robert E	213
	Cristal, Jenny	284
	Crompton, Nigel	. 62
	Cropp, T. Ashton	102
	Crossey, Laura	264
	Croteau, Maxine	302
	Crozier, Ross	132
	Crystallography	285
	CT scan	355
	Cuk, Matija	330
	Cumings, John	. 54
	Curtin, Robert F.	125
	Cycads	366
	Cytokines	339
	D	

D-beta-hydroxybutyrate...376 Dacke, Marie.....4 Dailey, Fred L....24 Davies, Melanie . . . . . . . . . 115 
 Davis, Devra
 .72

 Davis, Kenneth L.
 .165

 Davis, Vicki L.
 .62

 DDT
 .301

 de Donato, Philippe.
 .371

 Dehornoy, Patrick
 139

 Delinquency
 244

 DeMarzo, Angelo
 36

 Dementia
 125

 Demer, David A.
 308

 Demetri, George
 62

 Demirel, A. Levent
 278

 DeMott, Paul J.
 356

 Dendrites
 54, 77, 363

 Dengue fever
 4

 Denny, Mark W.
 390

 Department of Energy
 382

 Department of Energy ... 382 DePinho, Ronald A. ... 36, 371 Depression ..... 29, 117, 357

#### WWW.SCIENCENEWS.ORG

#### **INDEX** DEVELOPMENTAL BIOLOGY – HUBBLE SPACE TELESCOPE

Developmental biology 187,
Dewailly, Eric
Dey, Sudhansu 115
Dhondt, Andre
Diabetes 14, 104, 212, 398
Diakonov, Dimitri
Dickinson, Mark
Dickinson William R 132
Diener Edward 153
DiGeorge Syndrome 69
Dillehav Tom D 150
Dimetrov Dimitor S 241
Dinorpis gonus
Dioumaev, viadimir 158
DIOXINS
DNA 19, 29, 38, 70,
83, 84, 118, 164, 324
DNA chips
Dodabalapur, Ananth 133
Dodds, Peter S 103
Dogs 197
Dolphins 228
Dominy, Nathaniel
Donaldson, Ken
Doppler shift
Dourson, Larry R 230
Dowling, Jonathan P 220
Drewnowski, Adam 166
Drexler, Helmut
Driscoll, Monica
Drucker, Daniel J 104
Drueke, Tilman B 125
Drug delivery 260, 341, 398
Drug resistance
Drzaic Paul S 195
Dufresne Alexis 100
Dukes leffrey S 349
Dumesic James 45
Duritesic, James
Dust cosmic 282
Dust, Costilic
Dyes
Dysiexia
Dystne, Dag K

Epsilon-caprolactones         285           Escherichia coli         150           Ears         173           Earth, magnetosphere         372           Earth, magnetic field         213           Earth, mantle         174           Earthquakes         120           Eating         334           Ebola virus         83           Economics         251           Ecosystems, stability         10           Eggs         190           Edwards, Katrina J         381
Fight everyoning DNA
N dvoovloo
N-glycosyldse 164
Einstein, Albert
Elsenberger, Robert 153
El-Nduy, IIIdu F
Eluerity
Electrochomistry 270
Electrochemistry
Electromagnetism 187, 358
Electrons
Electron accelerators 340
Electronic displays 195
Electronics
Electronics, organic
Elliot, James L 126
EIIIS, Bruce J
Ellrod, Gary P 169

Ε

Ellstrand, Norman 232	Fluorotelomer alcohols	. 238
Embryos 115	Foam products	86
Emeralds	Foellmer, Matthias W	30
Emotions 141, 237, 293	Food preferences	. 165
Emslie, Steven	Foot-and-mouth disease	. 174
Endangered species 88, 102	Forbes, Duncan A	99
Endophytes	Ford, Kenneth M.	. 136
Endosulfan	Forest fires	. 388
Endothelin	Forgery	. 86
Endslev Mica 137	Forrest Stenhen	309
Eng John 104	Fortev Richard	221
Eng, John Francis 4	Fosalba Pablo	67
Environment 346	Foshury Pobert A E	201
Enhodra 224	Eoscile 10 42 141	172
Epidermal growth factor E1	PUSSIIS 17, 42, 141,	1/3,
		202,
Epilepsy		, 357
		. 106
	Fractures, bone	. 221
Eriksson, Per	Fraden, Seth	/
Eruptions	Fraiser, Claire M.	. 197
Esomeprazole	Frame dragging	. 280
Estes, Mary K 205	Frankel, Art	. 121
Estrin, Yuri 93	Fredkin, Edward	. 108
Estrogen 38, 133, 180, 302	Freedman, Deborah L.	. 132
Estrogens, environmental 67	Freeman, Walter J.	. 309
Ethanol 342	Frey, Harold U	. 372
Europa	Friedland, Gerald H	. 149
Europe, human occupation	Frieman, Joshua A.	67
	Friendship	. 282
Everglades	Fritzsche, Peggy	. 229
Everitt, C.W. Francis 281	Frogs	, 302
Evolution 30, 116, 126, 180,	Fromm, Michael D.	. 388
	Frost, Stephen R.	. 11
Exendin-4	Fruh-Green, Gretchen L.	. 52
Exercise 70	Frumkin Amos	221
Exosomes 363	Fuels	45
Expert systems 136	Fuel cells	270
Explosives 116	Fukomoto Takahiro	188
Extinctions 102 244 323	Eungi 7 35 110 358	37/
Extracolar planete 17/ 270	Eungicides	, 374
Extratorrostrial impacts 24	Eurgue farming	250
Extraterrestrial impacts 30,		222
Extratorroctrial life 200		
Extraterion	G	
EXU UVEI SIUIT		
Eyes//, 126		
F	Gaal Martin	52
	GΔRΔ	33 20

Faber, Sandra       53         Fabian, Andrew C.       163         Facial expressions.       237         Fairbairn, Daphne J.       30         Families.       35         Farming. See Agriculture	
Farrell, Richard J 51	
Farzan, Michael	
Fat cells	
Fatty acids, omega-3 253	;
Fehr, Ernst	
Fenessy, Julian	;
Fennimore, Adam 54	
Fentanyl61	
Ferguson, Harry 156	,
Fermions	
Ferroelectricity 86	,
Fiber optics 190, 218	;
Fink, George 100	)
Finkelstein, David B 243	;
Finn, M.G 8	;
Firbank, Les	
Fischetti, Vincent A 147	'
Fish78, 126, 198,	,
	5
Fishing 59, 85, 308	;
Fire retardants 266, 269,	,
Fleming, James G 219	)
Flessa, Karl W 43	;
HICK, Peter M	
Flight	)
Floods	•
Florida	
Fluid dynamics 68	

Foellmer, Matthias W	30
Food preferences	165
Foot-and-mouth disease	174
Forbes, Duncan A	99
Ford, Kenneth M.	136
Forest fires	388
Forgery	86
Forrest, Stephen	309
Fortey, Richard	221
Fosalba, Pablo	67
Fosbury, Robert A.E.	291
Fossils 19, 42, 141, 1	73,
221, 244, 253, 2	62,
	357
Fractals	106
Fractures, bone	221
Fraden, Seth	. 7
Fraiser, Claire M.	197
Frame dragging	280
Frankel, Art	121
Fredkin, Edward	108
Freedman, Deborah L.	132
Freeman, Walter J.	309
Frey, Harold U	372
Friedland, Gerald H.	149
Frieman, Joshua A	67
Friendship	282
Fritzsche, Peggy	229
Frogs	302
Fromm, Michael D.	388
Frost, Stephen R.	11
Fruh-Green, Gretchen L	52
Frumkin, Amos	221
Fuels	45
Fuel cells	270
Fukomoto, Takahiro	188
Fungi 7, 35, 110, 358, 3	374
Fungicides	35
Fungus farming	358
Funnell, Gregg F.	333
G	

Fluorotelomer alcohols. . . 238

Gaal, Martin
GABA
Galápagos Islands 211
Galaxies, distant 155
Galaxies, dwarf
Galaxies, elliptical 40
Galaxies, evolution of 40,
Galaxies, size
Galaxy clusters 275
Gale, Robert
Galef, Bennett G 78, 276
Galileo mission 196
Gallant, Joel E 222
Galli, Cesare
Gallium 285
Gallo, Robert
Galperin, Michael Y 29
Garrafo, H. Martin 149
Garvin, James B 298
Gas sensors 46
Gasoline
Gastroliths
Gavett, Stephen H 74
Geckos78
Gehrels, George E 132
Gehring, William J 326
Geist, Dennis
Gene therapy 45, 227
Genes, regulation 311
Genetic code 102
Genetic engineering 35, 382
Genetic vaccine 227
Genetically modified oranisms
See Transgenic plants
Génier, François5
Genomes 100, 197, 382
Gentry, Roger 228

Geodetic precession	. 280
Geomagnetic storms	. 3/2
Geometry	93
George, Nicholas	86
Gerald, William L	. 124
Germanium	. 285
Giavalisco, Mauro	. 155
Gibiat Vincent	300
Giedd, Jav N.	. 339
Gilad, Yoav	. 236
Gildor, Hezi	. 215
Gilstrap, Larry C.	. 340
Ginzburg, Vitaly L	. 229
Glaciers	215
Gladman, Brett	. 328
Glaser, Ronald	5
Glass, Roger I	. 205
Gleason, Karen	. 2/8
Gleene Grady I	, 285
Glial cells	. 350
Glial-cell-line-derived	
neurotrophic factor	. 245
Global warming, biologica	
effects	. 244
Glover Christopher A	00
Glowiak, Elizabeth M.	. 308
Glucagon-like peptide 1 .	. 104
Glucose	. 270
Gluons	3
Glutamate	. 350
Gobin Bruno	13
Goffredi, Shana K.	. 291
González-José, Rolando	. 150
Goodman, Philip C	. 186
Goodwin, Renee D	. 117
	. 355
Goss Paul F	
Gott, J. Richard 132	, 276
Gould, Stephen J.	. 364
Graham, Jeff	. 198
Grain	, 212
Granovetter, Mark	20
Granular flow	
Graphite	. 197
Grasses	. 358
Gravitation.	. 238
Gravitational waves	. 125
Gravity Probe R	, ∠ŏU 280
Grayson, Amv R.	. 260
Great Observatories Origin	ns
Deep Survey	. 155
Greenberg, David A	22
Greenberg, Jeff	. 152
Gregory Richard I	
Gresham, Frank.	. 259
Greyson, Bruce	. 109
Grigorenko, Elena L	. 131
Grimm, Rudolt	. 324
Grutter Alexandra	19 78
Guam.	. 366
Guggul extract	. 126
Guillot, Frank S	. 345
Gult War	. 269
Guthrie R Dale	. 318 307
Gyroscopes	. 280
п	

Hahn, Bevra Hannahs . . . . 388 Halaoui, Lara . . . . . . . . . . 92 Haley, Robert W. . . . . . . . . 269

100
Halzen, Francis L 109
Hammer Michael F 212
Hamscher Gerd 6
Handedness
Hands 222
Hanson, Robin 251
Happ, John W
Happiness
Harber, Philip
Hardy, Marcia L
Haroutunian, Vanram 165
Hartmann William K 37
Hartung lörg 6
Hatfull, Graham
Hathaway, David H 356
Hauser, Marc
Hayes, Robert A 195
Heaney, Robert P 134
Heart
Heart attack See Heart disease
194 222 224 244 272
Heart electrical stimulation
334
Hearty, Paul J
Heat-shock proteins 75
Heaton, Penny 205
Heavens, Alan F 158
Heberer, Thomas 68
Hebets, Eileen
Heldman Alan W
Heluman, Alam W 214 Helgeson John 24, 35
Helium 229 262 264
Hemorrhages
Henderson, Donald M 262
Henderson, Gregg 344
Henderson, Nick 115
Henzi, Peter
Hepatitis 276, 318
Hepatitis
Hepatitis276, 318Herenton, Willie121Hersam, Mark197Heura Arthur107
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Howe, Dama K         201
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K         201           Hicks Kenneth H         3
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         38           Higashino, Paul         89
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Jane         102
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Jame         102           Hill, Larry G.         107
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Jame         102           Hill, Larry G.         107           Hinrichs, Katrin         84
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         .3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Jane         102           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Kelichi         222
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K       201         Hicks, Kenneth H       .3         Higashino, Paul       89         Hilbert, David       139         Hildreth, James       363         Hill, Jane       102         Hilramatsu, Kelichi       222         Hites, Ronald A       260
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         .3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Kelichi         222           Hites, Ronald A.         266           HIV         .33, 149, 222, 260,           270         347         350
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363           Hill, Larry G.         107           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hirrinchs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hock, Christoph           Hoefen, Todd M.         301
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hirrinchs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hoefen, Todd M.           Hoefen, Todd M.         301           Holdaway, Richard N.         84           Holman, Matthew J.         328
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David       139         Hildreth, James       363         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Kelichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       .3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       .363         Hill, Larry G.       107         Hinrichs, Katrin       .84         Hiramatsu, Keiichi       .222         Hites, Ronald A.       .266         HIV       .83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David.         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hits, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hock, Christoph           Hock, Christoph         179           Hoefen, Todd M.         301           Holdaway, Richard N.         84           Holman, Matthew J.         328           Holography         86           Holstege, Gert         350           Holzenberger, Martin         76           Horm erectus         248           Homo erectus         248           Homo sapiens         248, 277, 389
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hits, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hock, Christoph           Hoefen, Todd M.         301           Holdaway, Richard N.         84           Holman, Matthew J.         328           Holography         86           Holstege, Gert.         350           Holzenberger, Martin         76           Horminids         45, 248           Homo erectus         248           Homo sapiens         248, 277, 389           Hong, Richard         70
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HIV         83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David       139         Hildreth, James       363         Hill, Jane       102         Hill, Jane       102         Hills, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       .3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       .363         Hill, Jane       102         Hill, Larry G.       107         Hinrichs, Katrin       .84         Hiramatsu, Keiichi       .222         Hites, Ronald A.       .266         HIV       .83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       363         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       363         Hill, Jane       102         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David       139         Hildreth, James       363         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hits, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hock, Christoph           Hoefen, Todd M.         301           Holdaway, Richard N.         84           Holman, Matthew J.         328           Holography         86           Holstege, Gert.         350           Holzenberger, Martin         76           Hormo sapiens         248, 277, 389           Hong, Richard         70           Hormone replacement therapy         133           Hormones, environmental         302           Hormones, environmental         302           Hormer, Ronnie D.         269           H
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hitz, Ronald A.         266           HIV         83, 149, 222, 260,           270, 347, 350, 363         Hock, Christoph           Hoefen, Todd M.         301           Holdaway, Richard N.         84           Holman, Matthew J.         328           Holography         86           Holstege, Gert.         350           Holzenberger, Martin         76           Hormo sapiens         248, 277, 389           Hong, Richard         70           Hormones         180, 261           Hormones         302           Hornere, Ronnie D.         269           Horses         83, 307           Hosoi, Anette P.         390
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       .3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       .363         Hill, Larry G.       107         Hinrichs, Katrin       .84         Hiramatsu, Keiichi       .222         Hites, Ronald A.       .266         HIV       .83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       121         Hersam, Mark       121         Heurs, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David.       139         Hildreth, James       363         Hill, Jane       102         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,
Hepatitis         276, 318           Herenton, Willie         121           Hersam, Mark         121           Hersam, Mark         197           Heuer, Arthur         69           Hews, Diana K.         201           Hicks, Kenneth H.         3           Higashino, Paul         89           Hilbert, David         139           Hildreth, James         363           Hill, Larry G.         107           Hinrichs, Katrin         84           Hiramatsu, Keiichi         222           Hites, Ronald A.         266           HV         83, 149, 222, 260,
Hepatitis       276, 318         Herenton, Willie       121         Hersam, Mark       197         Heuer, Arthur       69         Hews, Diana K.       201         Hicks, Kenneth H.       3         Higashino, Paul       89         Hilbert, David.       139         Hilbert, David.       139         Hill, Jane       102         Hill, Larry G.       107         Hinrichs, Katrin       84         Hiramatsu, Keiichi       222         Hites, Ronald A.       266         HIV       83, 149, 222, 260,

F

#### **INDEX** HUMANS, EVOLUTION – MUSHOTZKY, RICHARD

Ibata, Rodriguez A.         307           Ibuprofen.         115           Ice         356           Ice ages.         307           Ice shelves         278           Ichthyostega         173
Illes, Judy
IMAGE satellite
Imatinib mesylate 62, 285
Immunity 51, 54, 69,
IIILd5 170
Indonosia 159
Infonte 159 227
Infanto
Infinity 120
Inflammation 72 339 373
Infrared radiation 218 318
371
Inman Daniel I 365
Insects 317 318 344
Insulin
Insulin-like growth factor 75
Intelligence tests 259
Interferometry
Interleukins
Intestines
Inuits
Invertebrates
Iodine 230
Ion channels 3, 246
lons
IQ tests 259
Iron Age
Isoflavones 302
Ito, Fuminori 13
Ito Kikukatsu 380
10, ККИКИСССС

#### J

Jackson Joromy P.C 194
Jackson, W. Andrew 230
Jacobs, Gerald H 235
Jacobs, William R 28
Jacobs-Sera, Debbie 28
Jacobson, Joseph M 195
Jaffee, Sara R
Jager, Wolfgang
Jakobsson, Kristina 269
Jakosky Bruce M 298
lanssen Robert S 347
lanssens Robert V.E. 164
leffery William P 126
Jepson, Paul 228
Jets, astronomical 46
Jewitt, David C
Jin, Deborah S 324
Jin, Hyoung-Joon 173

Johnson, Stephen L 294		
Johnston, Kathryn V 99		
Jones, Daniel		
Jones, Hugh R.A 174		
Jones, Phil 166		
Jupiter 196, 325, 328		
К		

Johnson, Scott P..... 158

Kagan, Jerome	373
Kahn Ronald	76
	. 70
Kainay, Eugenia	293
Kanamori, Akihiro	141
Kanatzidia Marcouri C	20F
Kanatziuis, Mercouri G	205
Kanaya, Tomoe	259
Kanner Allen	152
Kanikian Albert 7	004
Kapikian, Albert Z	204
Kaplan, David	173
Koronth Subromanya	210
Karanun, Subramanya	310
Karato, Shun-Ichiro	174
Kardong Ken	200
	200
Karesh, William B	. 83
Karl David M	101
Karlinar Marak	245
Kariirier, warek	245
Kasser, Tim	152
Kattan Michaol W	122
Kattali, Wilchael W.	123
Kavelaars, J.J.	329
Kay Mark	227
Kay, Market Bassid	227
Kendali, David	. 24
Kenvon, Cynthia	. 75
Koro Juba	121
	131
Kessler, Ronald C 29	, 245
Kotonos	274
Kelulies	370
Ketten, Darlene	228
Ketterle Wolfgang	325
Klasela Curdeen	020
knosia, Sundeep	221
Kidnevs	125
Kieselt Cleaser Janico	
Kiecoit-Glaser, Janice	
Kierek, Katharine	293
Kiers Tohy	221
Kici 5, 100 y	221
Kilpatrick, C. William	. 1/9
Kimble, J. Jeffrey	182
Kinnamon Suo C	.02
KIIIIIdilloll, Sue C	
Kirkness, Ewen F.	197
Kirsch Jack E	102
	102
Klein, Daniel	348
Klein Daniel N	357
Klein John D	2/2
KIEIII, JOHH R	262
Klein, Richard G.	277
Kluger leffrev	33/
	0.04
кпір, мікаеі	213
Knoblauch, Michael,	180
Knutson Pogor	200
KIIULSOII, ROgel	300
Ko, Frank	206
Kohl Robert	16
	. 40
Koekernoer, Anton	155
Kolata, Alan L	198
Kondos Coorgo T	105
Kondos, George I	165
Konenkamp, Rolf	. 30
Koratkar Nikhil	16
	. 40
Kossiyn, Stephen M	309
Kotov, Nicholas	. 91
Krochmal Aaron	201
KIUCIIIIai, Aaluli	201
Kryder, Mark	. 171
Kuch, Wolfgang	172
Kudua Jayanth N	2/5
Kuuva, Jayantin N	305
Kugler, Alexander	165
Kuhn Steven	380
	JU7
Kulper belt	4 4 6
Kulinowski, Kristen	148
	148 366
Kullor Lowic	148 366
Kuller, Lewis	148 366 334
Kuller, Lewis	148 366 334 . 46
Kuller, Lewis Kuroda, Shun'ichi Kurzweil. Rav	148 366 334 . 46 107
Kuller, Lewis Kuroda, Shun'ichi Kurzweil, Ray	148 366 334 . 46 107 374
Kuller, Lewis Kuroda, Shun'ichi Kurzweil, Ray. Kwiterovich, Peter O.	148 366 334 . 46 107 376
Kuller, Lewis Kuroda, Shun'ichi Kurzweil, Ray Kwiterovich, Peter O	148 366 334 . 46 107 376
Kuller, Lewis Kuroda, Shun'ichi Kurzweil, Ray Kwiterovich, Peter O	148 366 334 . 46 107 376

	04
	200
	. 360
	. 355
	. 142
Lanograf, Markus	. 116
Langer, Robert	. 260
Langhals, Heinz	. 340
Larbalestier, David C	. 229
Laser printers	86
Lasers 14, 53, 18	1, 318
Lasky, Tamar	. 259
Latini, Giuseppe	. 173
Lattis, Richard	. 211
Lau, Christopher	. 142
Lau, Kenneth	. 278
Laudet Vincent	181
	262
Lautorbur Paul C	202
	. 227
	244
	. 344
Le Pecq, Jean-Bernard	. 363
Lead.	. 142
Learning 93, 228	3, 259
Leaves	. 311
Lechtman, Heather	. 198
Ledyard, John	. 252
Lee, Josephine B	. 342
Leggett, Anthony J	. 229
Lehmann, Kevin K.	. 262
Leigh, David A	93
Lemurs	. 333
Leong, Kam	. 227
Lennla Stenhen H	147
	3/19
	285
	. 20J
Leveniee, Raymonu J	. 100
	. 187
Levison, Hai F	. 148
Li, De-Kun	. 115
Li, Hongming	57
Liang, J. Felix	. 164
Liang, T. Jake	. 276
Lico	440
	. 118
Lichens	. 118 . 110
Lichens	. 118 . 110 . 218
Lichens Lighting Lilienfeld, Scott O	. 118 . 110 . 218 . 357
Lice Lichens Lighting Lilienfeld, Scott O.	. 118 . 110 . 218 . 357 . 235
Lice Lichens Lighting Lilienfeld, Scott O. Liman, Emily R. Lin. Shawn Yu	. 118 . 110 . 218 . 357 . 235 . 218
Lichens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindherg David R	. 118 . 110 . 218 . 357 . 235 . 218 . 291
Lichens Lighting Lilienfeld, Scott O Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindre Randal	. 118 . 110 . 218 . 357 . 235 . 218 . 291 232
Licens Lighting Lilienfeld, Scott O Liman, Emily R Lin, Shawn Yu Lindberg, David R Lindberg, Randal	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372
Lickens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindter, Randal Liotta, Lance	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245
Lickens Lighting Lighting Lilienfeld, Scott O. Liman, Emily R Lin, Shawn Yu Lindberg, David R. Linderg, Randal Liotta, Lance Liptin, Harry J.	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245
Lickens Lighting Lighting Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E.	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107
Lickens Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindberg, David R. Lindter, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W.	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 53
Lickens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindter, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J.	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 53 76
Lickens Lighting Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 53 76 86
Licens Lighting Lighting Lilienfeld, Scott O. Liman, Emily R Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 . 53 . 76 . 86 . 102
Lice Lichens Lighting Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen Liu, Lei	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 . 53 . 76 . 86 . 102 
Lickens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Hung-wen Liu, Lei Liu, Wilson M.	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 372 . 245 . 107 53 76 86 . 102 3 . 382
Licens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen Liu, Hung-wen Liu, Wilson M. Liver. 120	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 372 . 245 . 107 . 53 . 76 . 86 . 102 3 . 382 5, 292
Licens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linderg, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen Liu, Lei Liu, Wilson M. Liver. Livestock	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 . 53 . 76 . 86 . 102 3 . 382 5, 292 24
Licens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindtr, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Lei Liu, Wilson M. Liver. Liver. Liver. Liver. Livetock Livneh, Zvi	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 372 . 107 . 53 . 76 . 86 . 102 86 . 102 82 . 382 32 
Lickens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Hung-wen Liu, Chu-heng Liu, Chu-heng L	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 . 53 . 76 86 . 102 3 . 382 
Licens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance . Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Uison M. Liver . Livestock . Livneh, Zvi . Locke, Edwin A. Loeb, Avi	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 372 . 245 . 107 . 53 . 76 . 102 3 . 382 6, 292 24 . 163 . 132
Licens . Lighting . Lighting . Lighting . Liman, Emily R . Linderg, David R . Linderg, David R . Linderg, Randal . Liotta, Lance . Lipkin, Harry J . Lippitt, Carl E . List, Emil J.W. Lithgow, Gordon J . Lith, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Wilson M . Liver . Livestock . Livneh, Zvi . Locke, Edwin A. Loeb, Avi . Logic .	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 235 . 218 . 291 . 235 . 218 . 372 . 245 . 107 . 53 . 76 . 102 33 . 382 6, 292 . 24 . 102 33 . 382 . 245 . 107 382 382 
Lickens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Liphin, Harry J. Liphin, Harry J. Liphin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Lei Liu, Wilson M. Liver Livestock. Livestock. Livneh, Zvi Locke, Edwin A. Loeb, Avi Logic Lomnitz, Cinna	. 118 . 110 . 218 . 357 . 235 . 218 . 291 . 232 . 245 . 372 . 245 . 107 53 76 86 . 102 3 
Lickens . Lighting . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lipkin, Carl E. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Li	. 118 . 110 . 218 . 357 . 235 . 218 . 232 . 241 . 232 . 372 . 245 53 76 86 
Lickens . Lighting . Lighting . Lighting . Lingheld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance . Lippitt, Carl E. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Hung-wen . Liu, Vilson M. Liver . Livestock . Livneh, Zvi . Locke, Edwin A. Logic . Long, Stephen P. Longevity . 2010 . 20	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 245 . 207 . 232 . 245 . 372 . 372
Lickens . Lighting . Lileinfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Lindberg, David R. Lindta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen Liu, Uei. Liver. Liver. Liver. Liver. Liver. Liver. Liver. Liver. Locke, Edwin A. Loeb, Avi Logic Lomnitz, Cinna Long, Stephen P. Longevity. Lonsdale. Carol I	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 245 . 201 . 232 . 245 . 107 . 53 76 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Lindberg, David R. Lindter, Randal Liotta, Lance . Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Lei . Liu, Wilson M. Liver . Livestock . Livestock . Livestock . Livestock . Livestock . Livestock . Livestock . Locke, Edwin A. Loeb, Avi . Logic . Longvity . Longsotiphen P. Longevity . Long . Lon	. 118 . 110 . 218 . 357 . 235 . 218 . 235 . 218 . 231 . 232 . 372 . 245 26 26 63 
Lickens . Lighting . Lighting . Lighting . Linghefd, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance . Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Lord, Chu Liu, Chu-heng Liu, Chu-heng L	. 118 . 110 . 218 . 357 . 235 . 218 . 232 . 245 . 201 . 232 . 372 . 245 53 76 86 86 102 33 382 3 33 382 3 382 
Lickens . Lighting . Lighting . Lighting . Lingheld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Lit, Chu-heng Liu, Hung-wen Liu, Hung-wen Liu, Lei Liu, Wilson M. Liver. Liver. Livestock. Livneh, Zvi Locke, Edwin A. Loeb, Avi Logic Lommitz, Cinna Long, Stephen P. Longsdie, Carol J. Lord, Elizabeth Lorence, David Lorence, Rach	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 232 . 245 . 372 . 245 . 53 76 86 . 102 3 382 3 
Lickens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Hung-wen Liu, Lei Liver. Liver. Liver. Liver. Liver. Liver. Liver. Locke, Edwin A. Loeb, Avi Logic Lomnitz, Cinna Long, Stephen P. Longevity. Lord, Elizabeth Lorenz, Ralph Lou Gebrie's discase.	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 232 . 245 . 201 . 232 . 245 . 107 . 53 76 86 . 102 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Lindberg, David R. Linder, Randal Liotta, Lance . Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng . Liu, Wilson M. Liver . Liu, Wilson M. Liver . Livestock . Livestock . Livestock . Livestock . Livestock . Locke, Edwin A. Loeb, Avi . Long, Stephen P. Longsvity . Londale, Carol J. Lorndale, Carol J. Lorenz, Ralph . Lou Gehrig's disease . 2	. 118 . 110 . 218 . 357 . 238 . 238 . 291 . 232 . 372 . 245 232 245 107 53 76 86 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Liptit, Carl E. Liptit, Carl E. List, Emil J.W. Lithgow, Gordon J. Lithgow, Gordon J. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Hung-wen Liu, Chu-heng Liu, Chu-heng Lord, Elizabeth Lord, Chu-heng Lord, Malter Lord,	. 118 . 110 . 218 . 357 . 238 . 238 . 237 . 232 . 245 273 53 76 86 102 53 76 86 
Lickens . Lighting . Lighting . Lighting . Lingheld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Lit, Chu-heng Liu, Hung-wen Liu, Lei Liu, Wilson M. Liver. Liver. Livestock. Livneh, Zvi Locke, Edwin A. Logic Lommitz, Cinna Long, Stephen P. Longevity. Lord, Elizabeth Lorence, David Lorence, Ralph Lou Gehrig's disease. 2 Love, Stephen P. Loveland, Walter Loveland, Walter	. 118 . 110 . 218 . 357 . 238 . 291 . 232 . 245 . 291 . 232 . 245 . 107 . 53 76 86 . 102 3 3 3 
Lickens . Lighting . Lilienfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Uei Liu, Wilson M. Liver Liv, Wilson M. Liver Livestock Livneh, Zvi Locke, Edwin A. Loeb, Avi Logic Lomnitz, Cinna Long, Stephen P. Longevity Lornz, Ralph Lou Gehrig's disease. 22 Love, Iangen B. Loveland, Walter Loveland, Walter	. 118 . 110 . 218 . 357 . 235 . 218 . 232 . 235 . 218 . 291 . 232 . 372 . 245 . 107 53 76 86 . 102 33 33 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Lindberg, David R. Linder, Randal Liotta, Lance . Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Chu-heng . Liu, Hung-wen . Liu, Uison M. Liu, Hung-wen . Liu, Wilson M. Liver . Liver . Livestock . Livneh, Zvi . Locke, Edwin A. Loeb, Avi . Logic . Lomdale, Carol J. Lorndale, Carol J. Lorndale, Carol J. Lorndale, Carol J. Lornez, Ralph . Lou Gehrig's disease22 Love, Stephen P. Loveland, Walter . Loveland, Walter . Love, Derek R. Low, Donald .	. 118 . 110 . 218 . 357 . 235 . 218 . 237 . 235 . 218 . 291 . 232 . 372 . 245 53 76 86 86 3 382 3 382 3 3 382 3 3 3 3 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Liphtit, Carl E. Liphtit, Carl E. Liphtit, Carl E. List, Emil J.W. Lithgow, Gordon J. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng	. 118 . 110 . 218 . 357 . 238 . 235 . 238 . 232 . 245 . 372 . 245 53 76 86 86 102 
Lickens . Lighting . Lighting . Lighting . Lingheld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Liphit, Carl E. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Hung-wen Liu, Lei Liu, Wilson M. Liver. Liver. Livetock. Livneh, Zvi Locke, Edwin A. Loeb, Avi Logic Lormhitz, Cinna Long, Stephen P. Longevity. Lord, Elizabeth Lorence, David Lorence, Ralph Lou Gehrig's disease. Loveland, Walter Loveland, Walter Lovel, Cetter. Low, Donald. Lu, Kun Ping Lucas, Peter.	. 118 . 110 . 218 . 357 . 238 . 238 . 239 . 232 . 245 . 372 . 245 . 372 . 374 . 372 . 372 . 374 . 370 . 372 . 374 . 370 . 372 . 374 . 370 . 372 . 374 . 372 . 372
Lickens . Lighting . Lileinfeld, Scott O. Liman, Emily R. Lin, Shawn Yu Lindberg, David R. Linder, Randal Liotta, Lance Lipkin, Harry J. Lippitt, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Liu, Chu-heng Liu, Lei Liu, Wilson M. Liver Liu, Wilson M. Liver Livestock Livreh, Zvi Locke, Edwin A. Loeb, Avi Logic Lomnitz, Cinna Long, Stephen P. Longevity Lornace, David Lorenz, Ralph Lou Gehrig's disease. Lovel, Stephen P. Loveland, Walter Loveland, Walter Loveland, Walter Loveland, Walter Loveland, Luck, Speter. Lucy hominid.	. 118 . 110 . 218 . 357 . 235 . 235 . 235 . 235 . 235 . 237 . 235 . 237 . 245 . 372 . 245 . 372 . 245 . 107 . 53 . 76 . 36 . 102 . 33 . 382 . 245 . 382 . 244 . 153 . 132 . 132 . 132 . 132 . 201 . 20
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Harry J. Lipkin, Carl E. List, Emil J.W. Lithgow, Gordon J. Liu, Chu-heng Liu, Chu-heng Lores, Edwin A. Lores, Carl J. Lord, Elizabeth Lorenz, Ralph Lou Gehrig's disease. 2' Love, Stephen P. Love, Stephen S. Stephen S. Stepheng, Stephen S. Stephe	. 118 . 110 . 218 . 357 . 235 . 218 . 232 . 235 . 218 . 232 . 372 . 245 53 76 86 102 33 382 33 382 33 382 33 382 
Lickens . Lighting . Lighting . Lighting . Linderfeld, Scott O. Liman, Emily R. Lindberg, David R. Lindberg, David R. Lindberg, David R. Lindter, Randal Lindter, Randal Lindter, Randal Lindter, Randal Liptit, Carl E. Liptit, Carl E. List, Emil J.W. Lithgow, Gordon J. Lit, Chu-heng Liu, Chu-heng Liu, Hung-wen Liu, Chu-heng Liu, Hung-wen Liu, Lie. Liu, Wilson M. Liver. Liu, Wilson M. Liver. Livestock. Livneh, Zvi Locke, Edwin A. Loeb, Avi Logic . Lomnitz, Cinna Long, Stephen P. Lorence, David Lorence, David Lorence, Ralph Lou Gehrig's disease. 2' Love, Stephen P. Loveland, Walter Love, Stephen P. Loveland, Walter Love, Stephen P. Loveland, Walter Love, Stephen S. Love, Stephen S.	. 118 . 110 . 218 . 357 . 238 . 238 . 235 . 218 . 291 . 232 . 372 . 245 33 76 86 102 33 76 86 33 76 33 

Lunine, Jonathan I.				214
Lvov, Yuri				. 91
Lyon, Andrew				206

#### Μ

Ma. Jingvuan	
Mabury, Scott	
Mackin, Will 201	
MacKinnon, Roderick 246	
Maclean, Jay 60	
Madsen, Eugene	
Magentic resonance imaging .	
Magnetic fields 13/ 372	
Magnetism 14 171 229 254	
Magnuson, Leif	
Maguire, Jamie L 350	
Mahadevan, Lakshminarayanan	
Majewski, Steven R 382	
Malan Ir T Philin 100	
Malka Ariel 154	
Mallouk, Thomas	
Mammals 10	
Manalis, Scott 116	
Manic depression 164	
Mann, Nicholas H 100	
Manville Vern	
Mans 212	
Margoliash, Daniel	
Margot, Jean-Luc 277	
Maria, Anna	
Marijuana	
Marine organisms 69, 190, 228	
Markert M Louise 70	
Markets 251	
Marks, Andrew R 214	
Marks, Tobin 133	
Marriage 189	
Marriage	
Marriage	
Marriage	
Marriage	
Marriage         189           Mars         61, 148, 157, 298, 301, 366           Mars, moons         301, 366           Mars, moons         328           Mars, water on         298, 397           Marshall, Curtis H.         292           Martienssen, Robert         314	
Marriage	
Marriage         189           Mars         61, 148, 157, 298,	
Marriage         189           Mars         61, 148, 157, 298,           Mars, moons         301, 366           Mars, moons         328           Mars, water on         298, 397           Marshall, Curtis H         292           Martienssen, Robert         314           Martin, Mary Beth         38           Mason, Andrew         201           Mason, Georgia         211           Mating strategies         276	
Marriage         189           Mars         61, 148, 157, 298,	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       228         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139	
Marriage       189         Mars       61, 148, 157, 298,	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Mattoor, Rollw       205	
Marrage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254	
Marrage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Matero, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Mazinger, Polly       254         Maurer, Daphne       331	
Marrage	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavchickel G       332         McBrearty, Sally       277	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Georgia       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzer, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavroidis, Constantinos       180         May, Michael G.       332         McBrearty, Sally       277         McBride, Brian F.       334	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Mazy, Michael G.       332         MCBrearty, Sally       277         McBride, Brian F.       334         McCarron, David A.       125	
Marrage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         May, Michael G.       331         Mayroidis, Constantinos       180         May, Michael G.       332         McCarron, David A.       125         McCarthy, Joseph J.       57         McClarthy, Koley Mathe K       272	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Matzoo, Autar       35         Matzger, Adam       206         Mazinger, Polly       254         Maurer, Daphne       331         Mavroidis, Constantinos       180         May, Michael G       332         McBraeraty, Sally       277         McCarron, David A       125         McCarron, David A       37         McClintock, Martha K       373         McCormick, Frank       357	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mater, Jill       202         Materials science       86, 93, 190         Mattendis science       86, 93, 190         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavroidis, Constantinos       180         May, Michael G       332         McBride, Brian F       334         McCarron, David A       257         McClintock, Martha K       373         McCormick, Joseph J       57         McClintock, Martha K       357	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Mattials science       86, 93, 190         Materials science       86, 93, 190         Matematics       93, 139         Matzo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavroidis, Constantinos       180         May, Michael G.       332         McCarron, David A.       125         McCarthy, Joseph J.       57         McClintock, Martha K.       373         McCormick, Frank.       357         McCormick, Joseph B.       83         McCurdy, Howard E.       203	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Mattenials science       86, 93, 190         Materials science       86, 93, 190         Materials science       86, 93, 190         Matter, Juli       202         Matter, Juli       202         Materials science       86, 93, 190         Matter, Juli       202         Materials science       86, 93, 190         Matter, Juli       202         Materials science       86, 93, 190         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         McCarron, David A       125         McCarthy, Joseph J.       57         McClintock, Martha K <td></td>	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavoidis, Constantinos       180         May, Michael G.       332         McBrearty, Sally       277         McCarron, David A.       125         McCarthy, Joseph J.       57         McClintock, Martha K.       373         McCormick, Joseph J.       57         McCormick, Joseph B.       337         McCormick, Joseph B.       337         McCormick, Joseph B.       37         McCormick, Joseph B.	
Marriage       189         Mars       61, 148, 157, 298,         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mason, Georgia       211         Mating strategies       276         Mateo, Jill       202         Materials science       86, 93, 190         Mathematics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Matzinger, Polly       254         Maurer, Daphne       331         Mavroidis, Constantinos       180         May, Michael G.       332         McCarron, David A.       125         McCarthy, Joseph J.       57         McClintock, Martha K.       373         McCormick, Frank.       357         McCormick, Joseph B.       83         McCurdy, Howard E.       203         McDonald, Gregory       19         McEwen, Bruce S.       166 </td <td></td>	
Marrage       189         Mars       61, 148, 157, 298,	
Marrage       189         Mars       61, 148, 157, 298,	
Marrage       189         Mars       61, 148, 157, 298,	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mate, Jill       202         Materials science       86, 93, 190         Matenatics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         May, Michael G.       332         McCarron, David A.       125         McCarron, David A.       125         McCarron, Joseph J.       57         McClintock, Martha K.       373         McCormick, Joseph B.       83         McCurdy, Howard E.       203         McDonald, Gregory.       19         McKeever, Jason       181         McKellar, A. Robert W.       262         McKnight, Diane       315         McCarnick, Joseph B.       33         McCormick, Joseph B. <td< td=""><td></td></td<>	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       301, 366         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mate, Jill       202         Materials science       86, 93, 190         Matenatics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         May, Michael G.       332         McCarron, David A.       125         McCarron, David A.       125         McCarron, David A.       125         McCarron, Joseph J.       57         McClintock, Martha K.       373         McCornick, Joseph B.       83         McCurdy, Howard E.       203         McCornick, Joseph B.       83         McCurdy, Howard E.       203         McCornick, Joseph B.       348         McKeever, Jason       181         McKeilar, A. Robert W.       262         McKnight, Diane	
Marrage       189         Mars       61, 148, 157, 298, 301, 366         Mars, moons       328         Mars, water on       298, 397         Marshall, Curtis H.       292         Martienssen, Robert       314         Martin, Mary Beth       38         Mason, Andrew       201         Mason, Georgia       211         Mating strategies       276         Mate, Jill       202         Materials science       86, 93, 190         Matenatics       93, 139         Mattoo, Autar       35         Matzger, Adam       206         Maty, Michael G.       332         McBrade, Brian F.       334         McCarron, David A.       125         McCarthy, Joseph J.       57         McClintock, Martha K.       373         McCarron, David A.       125         McCarthy, Joseph B.       357         McCormick, Joseph B.       358         McCurdy, Howard E.<	

Maakar Alan K
Meeker, Aldri K
Meinwald, Jerrold 149
Meissner effect
Melatonin 13
Meltzer David I 150
Memory 182 228 203 300
Mierroly 102, 220, 275, 307
Microelectro-mechanical
systems 54
Mental capabilities 325
Mental illness 29 157
Montal retardation 259
Mentawal Islands 158
Mercola, Mark 188
Mercury
Meruelo Daniel 356
Mocone 281
Mesothelioma21
Messenger, Matthew T 345
Messer William B 4
Motabolism 145
Meteorology
Methyl bromide 118
Methyl tert-hutyl ether 342
Mothylopodiow/moth
weuryieneuloxyineur-
ampnetamine 221
Meyers, Lauren A 12
Micelles
Microchins 240
Microelectronics 53
Microlasers
Micromachines 180
Microorganisms 7 270
WICTOUR gallistits
Migration 29, 84, 310
Mihos, Chris 40
Milgram Stanley 103
IVIIIK
Milky Way Galaxy 99, 307,
Millam James R 78
Millor Charlos 206
Willer, Charles
Miller, Christopher 246
Miller, Ed
Miller, Christopher 246 Miller, Ed
Miller, Christopher 246 Miller, Ed
Miller, Christopher.         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315
Miller, Christopher         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389
Miller, Christopher.         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115
Miller, Christopher.         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Misciles         359
Miller, Christopher         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mistai John         292
Miller, Christopher         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mitani, John         283
Miller, Christopher.         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mitani, John         283           Mitchell, S. Weir.         245
Miller, Christopher         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mitani, John         283           Mitchell, S. Weir.         245           Mitragotri, Samir         341
Miller, Christopher.         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Miskins         359           Mitani, John         283           Mitchell, S. Weir.         245           Mitragotri, Samir.         341
Miller, Christopher.         246           Miller, Ed         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mitani, John         283           Mitchell, S. Weir         245           Mitragotri, Samir         341           Moas         84
Miller, Christopher.         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Missilles         359           Mitani, John         283           Mitragotri, Samir         245           Mitragotri, Samir         341           Moas         84           Molecular motors         93
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minnig.       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles.       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180
Miller, Christopher.         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Miskin, Chad         7, 389           Miscarriages         115           Missilles         359           Mitani, John         283           Mitragotri, Samir         245           Mitragotri, Samir         341           Moas         84           Molecular motors         93           Mollon, John D.         235           Mollusks         180           Mondlooch, Catherine J.         331
Miller, Christopher.         246           Miller, Ed         168           Miller, M. Coleman         281           Minng         315           Mirkin, Chad         7, 389           Miscarriages         115           Missiles         359           Mitani, John         283           Mitchell, S. Weir.         245           Mitragotri, Samir         341           Moas         84           Molecular motors         93           Mollon, John D.         235           Mollusks         180           Mondlooch, Catherine J.         331
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Mapke, Ioo       284
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitragotri, Samir       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montemagno, Carlo       180
Miller, Christopher.       246         Miller, Ed       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Miskins       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montemagno, Carlo       180
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montgomery, David C.       118
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       181, 397         Monkeys       181, 397         Monkeys       181, 397         Monkeys       181, 397         Montgomery, David C.       68         Montreal Protocol       118         Montgate Stophon A       112
Miller, Christopner.       246         Miller, Ed       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Miskins       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montreal Protocol       118         Montzka, Stephen A.       118
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montgred Protocol       118         Moon.       254
Miller, Christopher.       246         Miller, Ed       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Mon.       254         Morphine.       61
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minng       315         Mirkin, Chad       7, 389         Miscarriages       115         Misiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys       181, 397         Monkeys, Joe       286         Monner, Hans Peter       362         Montemagno, Carlo       180         Montgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moornin, Martina M       355
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       286         Montgomery, David C.       68         Montgrenery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Montrin, Martina M.       355
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       155         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montremagno, Carlo       180         Montzka, Stephen A.       118         Moon       254         Morrin, Martina M.       355         Morrin, Martina M.       355
Miller, Christopner.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys       181, 397         Montgomery, David C.       68         Montrgomery, David C.       68         Montrgomery, David C.       118         Moon.       254         Morphine.       61         Morrin, Martina M.       355         Morvood, Michael J.       250
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Montgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moorrin, Martina M.       355         Morrins, Stephen W.       56         Morrins, Stephen W.       56         Morrins, Stephen W.       56         Morvood, Michael J.       250         Moser, Marvin       374
Miller, Christopner.       246         Miller, Ed       168         Miller, M. Coleman       281         Minnig       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montreal Protocol       118         Montzka, Stephen A.       118         Moon       254         Morphine.       61         Morrin, Martina M.       355         Moris, Stephen W.       56         Morwood, Michael J.       250         Moses, Jeffrey W.       214
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montgomery, David C.       68         Montzka, Stephen A.       118         Moon.       254         Morphine.       61         Morrin, Martina M.       355         Moses, Jeffrey W.       56         Morose, Jacpher W.       56         Moses, Jeffrey W.       214
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montreal Protocol       118         Moon       254         Morphine       61         Morrin, Martina M.       355         Moris, Stephen W.       56         Moweod, Michael J.       250         Moseer, Marvin       374      <
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning.       315         Mirkin, Chad       7, 389         Miscarriages       115         Miskins       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montreal Protocol       118         Montzka, Stephen A.       118         Montzka, Stephen A.       118         Morrin, Martina M.       355         Morris, Stephen W.       56         Morwood, Michael J.       250         Moser, Jarey W.       214         Mosher, Fredrick R.       169         Mosquitoes       30
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollon, John D.       235         Mollosks       180         Mondlocch, Catherine J.       331         Monkeys       181, 397         Montky, Joe       286         Montrgomery, David C.       68         Montgomery, David C.       68         Montgomery, David C.       61         Morrin, Martina M.       355         Morrin, Stephen W.       56         Morses, Jeffrey W.       214         Mosher, Fredrick R.       169         Mosey.       30         Motion analysis.       389
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montremagno, Carlo       18         Montzka, Stephen A.       118         Montzka, Stephen A.       118         Morrin, Martina M.       355         Morsis, Stephen W.       56         Morwood, Michael J.       250         Moses, Jeffrey W.       214         Mosher, Fredrick R.
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minng       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys       181, 397         Montgomery, David C.       68         Montrgomery, David C.       68         Montrgomery, David C.       68         Montrgonery, David C.       68         Montrgonery, David C.       68         Montrgonery, David C.       68         Montrgonery, David C.       68         Montry, Martina M.       355         Morrin, Martina M.       355         Morsey, Jeffrey W.       250         Moser, Fredrick R.       169         Mosquitoes       30         Motio
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minning       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Montgomery, David C.       68         Montreal Protocol       118         Moon.       254         Morphine.       61         Morrin, Martina M.       355         Morse, Jeephen W.       56         Moser, Fredrick R.       169         Mosey, Jeffrey W.       214         Mosher, Fredrick R.       169         Mosquitoes       30         Motor       54         Morticks.       389         Motor       54         Motor       54         Motor
Miller, Christopner.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montreal Protocol       118         Montzka, Stephen A.       118         Montzka, Stephen A.       118         Mornin, Martina M.       355         Morris, Stephen W.       56         Morwood, Michael J.       250         Moser, Fredrick R.       169         Mosquitoes
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minnig.       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles.       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys       181, 397         Monkeys       181, 397         Montkop, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montrgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moornin, Martina M.       355         Moses, Jeffrey W.       56         Morwood, Michael J.       250         Moser, Marvin       374         Moses, Jeffrey W.       214         Moshor, Fredrick R. </td
Miller, Christopner.       246         Miller, Ed       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moon       254         Morrin, Martina M.       355         Morris, Stephen W.       56         Morwood, Michael J.       250         Moses, Jeffrey W.       214
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Misking       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montregomery, David C.       68         Montregomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moornin, Martina M.       355         Morris, Stephen W.       56         Moser, Fredrick R.       169         Mosaguitoes       30         Motion analysis.       389         Motor       54         Morphine.       56         Morony Markina M.       355
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles.       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollon, John D.       235         Mollosks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Montrgomery, David C.       68         Montgomery, David C.       68         Montgromery, David C.       68         Montrin, Martina M.       355         Moses, Jeffrey W.       214         Mosher, Fredrick R.       169         Mortin analysis       389         Motor       54         Mortina analysis       389         Motor       54         Mollon, Inthaller, Wolfgang       317
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       311         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montreal Protocol       118         Montzka, Stephen A.       118         Montzka, Stephen A.       118         Mornin, Martina M.       355         Morris, Stephen W.       56         Morwood, Michael J.       250         Moser, Fredrick R.       169         Mosquitoes
Miller, Christopner.       246         Miller, Ed.       168         Miller, M. Coleman       281         Minng       315         Mirkin, Chad       7, 389         Miscarriages       115         Misking       359         Mistariages       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       181         Monkeys       181, 397         Montgomery, David C.       68         Montrgomery, David C.       68         Montrgomery, David C.       68         Montry, Martina M.       355         Morrin, Martina M.       355         Morwood, Michael J.       250         Moser, Fredrick R.       169         Mosquitoes       30         Motion analysis.       389         Motor       54 <t< td=""></t<>
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitragotri, Samir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montreal Protocol       118         Moon       254         Morrin, Martina M.       355         Morris, Stephen A.       118         Moser, Fredrick R.       169         Mosquitoes       309         Motor       54         MRI.       123, 229         Mudelsee, Manfred       166
Miller, Christopher.         246           Miller, Ed.         168           Miller, M. Coleman         281           Mining         315           Mirkin, Chad         7, 389           Miscarriages         115           Mirkin, Chad         7, 389           Miscarriages         115           Mirkin, Chad         7, 389           Miscarriages         115           Mitrai, John         283           Mitchell, S. Weir.         245           Mitragotri, Samir.         341           Moas         84           Molecular motors         93           Mollon, John D.         235           Mollusks         180           Mondlooch, Catherine J.         331           Monks, Joe         286           Monner, Hans Peter         362           Montreal Protocol         118           Montzka, Stephen A.         118           Montral Protocol         118           Mornin, Martina M.         355           Morris, Stephen W.         56           Morwood, Michael J.         250           Moser, Fredrick R.         169           Mosaquitoes         30
Miller, Christopher.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Missiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monkeys       181, 397         Monkeys       181, 397         Monkeys       181, 397         Montgomery, David C.       68         Montrgomery, David C.       68         Montrgomery, David C.       68         Montrgonery, David C.       68         Mortrin, Martina M.       355         Morrin, Martina M.       355         Morser, Fredrick R.       169         Moser, Fredrick R.       169         Moser, Fredrick R.       169         Mostor       54         Motion analysis.
Miller, Christopner.       246         Miller, Ed.       168         Miller, M. Coleman       281         Mining       315         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mirkin, Chad       7, 389         Miscarriages       115         Mitsiles       359         Mitani, John       283         Mitchell, S. Weir.       245         Mitragotri, Samir.       341         Moas       84         Molecular motors       93         Mollon, John D.       235         Mollusks       180         Mondlooch, Catherine J.       331         Monkeys       181, 397         Monks, Joe       286         Monner, Hans Peter       362         Montgomery, David C.       68         Montreal Protocol       118         Montzka, Stephen A.       118         Moon       254         Morrin, Martina M.       355         Morris, Stephen W.       56         Morwood, Michael J.       250         Moses, Jeffrey W.       214

**INDEX** MUSSER, JAMES – SHIFT WORKERS

Olfactory cortex ..... 238

Musser, James M 27
Muzykantov, Vladimir 93
Muzzio, Fernando J 56
Myelin
Myers, Norman 85
Myers, Ransom A 59
Mysliwiec, Pauline A 355

#### Ν

Nabel, Gary J.,	2
Nakano Takashi	3
Nander Karim 22	8
Nanorods	7
Nanoshells 333 38	1
Nanotechnology 7 46	5
54 91 180 36	6
Nanotubes 46 54 142 182	>
206 278 32	4
NASA	o
Navier-Stokes equations 6	8
Near Farth Asteroid	0
Rendezvous 27	7
Need Eleanor 18	1
Neff Susan G	'n
Nel Andre 7	4
Nelson Karin B 34	ň
Nemani Ramakrishna R 1	3
Neonhobia 7	8
Nentune 32	2
Nerves 14 99 24	5
Nervous system	0
Netzer William I 28	5
Neurotovicity 26	2
Neurone 2	1
Noutrinos 10	0
Neviranine 27	7 0
New Madrid fault zone 12	n
Now Zoaland	л Л
Nowborg Hoidi Io	47
Newchurch Mike 11	/ Q
Nowoll Stovon V	0
Nowman Dianno K 20	о л
Nicholson Bhilin D	4
Nicholson Torosa	1
Nickol 14	י כ
Niedbala Com	0 0
Nightingala Joromy	0 1
Nilsson Coran E	1 0
Nitrogon ovelo	1
Nitrous ovido	ו ר
Nobol prizos 220 24	∠ د
Nogues locop 17	0 1
Nolta Michael P	י ד
Nonstaraidal anti inflammator	/
	y c
UIUSS	3
Nordtvodt Konnoth	2
	0 2
North Kethnin	3
North, Kathryn	0 1
Novack, Depurari V	1
Novak, Joseph	1
Novas, Fernando E	3
Noverty-seeking benavior	
Nowieki Stove	3
NOWICKI, SLEVE	2
0	

O'Brien, Jim
O'Brien, Robert T
O'Hagan, Patrick 365
O'Keefe, Sean 203
O'Malley, Bert 181
Obando, Rodrigo 107
Ober, Elke A 126
Oberhauser, Karen 310
Obesity 238
Observatories
Oceans 26, 101, 195
Ohno, Hideo 171
Olesen, Sanne H

414

Sanne H		. 6	52				218,	3
DECEMBER	20	&	27,	2003	VOL.	164		

Olive oil	Phototherapy 333, 381
Olivine	Photovoltaic devices 30,
Olson, Donald W6	
Ombolt Stig 122	Pritrialates
Onhir Alexander G 78	Pielke Sr Roger A 292
Opsin	Piezoelectricity
Optics 86, 181, 190, 218	Pigs 24
Optoelectronics53	Pinkerton, Kent E 72
Oremland, Ronald S 316	Pinnaduwage, Lal 116
Organochlorines	Pischon, Tobias
Origin of life 29, 157, 285	Plant fertility 39
Orozco, Luis A	Plantar fasciitis
Orszag, Steven A 68	Plants
Ortiz-Garcia, Sol 233	
Osorio, Daniel 234	Plants, self-warming 379
Osteoporosis	Plastics
Östlund Nilsson Sara 198	173, 269, 285, 301 Distolate
Ostracode 357	Platinum 163
Ottino, Julio M.	Plott. Charles
Overfishing	Pluto
Owen-Smith, Norman 284	Pneumococcal vaccine 222
Ozone 118	Poets, Christian F 173
D	Poindexter, John 251
F	POIK, D. Brent
	Pollen 39
Page Jr., Robert	Pollination
Page, Susan	Pollution 72, 94, 254, 302
Pain 99, 115, 237, 245, 398	Polybrominated diphenyl ethers
Palenik, Brian 100	
Pan, Hui-Lin	Polychlorinated biphenyls
Pari, Julie W	Polyelectrolytes 01
Pangeotakos Demosthenes B	Polymers 53 86 133 206
Papovich, Casey 156	Polymers, conducting 53
Parasites 116	Polypropylene 86
Parenting	Polyvinyl chloride 285
Paricalcitol	Poorter, Lourens
Parkinson's disease 376	Porpoises
Parrots 78	Posttraumatic stress disorder
Particle physics 3, 181, 189,	
	Potatoes
Particulates 30, 72	Potter, Kenneth W 166
Patterson, Tony	Potts, Richard 10
Pauly, Daniel	Poultry
Peat hogs 22	Powder mixing 56
Pecoraro, Norman C 165	Powers, Susan E
Pedulla, Marisa 26	Prata, Fred 170
Pell, Eva	Prausnitz, Mark R 341
Pence, Valerie	Predation 148, 195, 294,
Pendry, John B	Drognanov 115 172
116	Pressvanov Dobromir S 13
Peppas, Nicholas,	Prestwood, Karen M 134
Perception 158, 308, 331	Preuss, Daphne
Perchlorate	Primates 181, 234, 333
Peres, Carlos A 390	Progesterone 133
Perfetti, Riccardo 104	Projan, Steven J
	Prometheus 126 Proposition 65 285
Perin, Emerson C	Prostaglandins 115
Periodic table	Prostate gland
Perlman, Steve 89	Prostate-specific antigen
Permian extinctions 323	
Perry, Susan 181	Proteases
	Proteins inflammatory
Pesticides	
	334
Peters, Winfried S 180	Proteomics
Peters, Winfried S	Proteomics         334           Przedborski, Serge         371
Peters, Winfried S 180 Peterson, A. Townsend 310 Petricoin, Emanuel	334 Proteomics
Peters, Winfried S	334           Proteomics         371           Przedborski, Serge         377           Psychiatric disorders         157           Psychotherapy         357, 398           Puberty         372           Pugh, George W.         280           Pullendran, Bali         77           Pulsars         53, 125

Photosynthesis . . . . . . . 100

0
Quantum chromodynamics
ĸ
Racial groups.       325         Radar.       213         Radiation therapy
Ricaurte, George

 Rodents
 179

 Rogers, John A.
 53

Rollman, Bruce L. . . . . . . 117

Rothstein, Jeffrey D. .... 350

Rothstein, Stephen . . . . . 116

Ruby, Stanley. . . . . . . . . 107 Rucker, Rudy . . . . . . . . . 107 Ruiz-Linares, Andrés . . . . . 85

Ruvkin, Gary	76
S	
Sacks, Oliver	32 22
Sagittarius uwart galaxy 3 Sailor Michael	٥८ 57
Salved Habibullah	37 72
Salamon Michael H 2	/ 2 81
Salem Aliasager 2	28
Salinas, Leonard J.	68
Salomon, Christophe 3	25
Salt	3
Sánchez-Villagra, Marcelo R.	
Sand dunes	79 97
Sandidge, Jamel	94
Sandorfi, Andrew M	3
Sarikaya, Mehmet	69
SARS	34
Satellites	28
Saturn	28
Savona Pravoon	52 20
Scavenging 2	20 9Л
Scerri. Eric	65
Schardl, Christopher 3	74
Schatz, Richard A 2	14
Schecter, Arnold 20	66
Scheiman, James M 3	33
Schernhammer, Eva S.	13
Schift, Leonard I	80
Schildhulzen, Menno 24	43
Schizophrenia 164 2	28 10
Schlenoff Joseph	91
Schmidt Julie B 3	47
Schor, Juliet B.	53
Schuller, Ivan K 1	71
Schultz, Peter G 10	02
Schultze-Motel, Paul 3	80
Schulz, Richard	5
Schurr, Theodore G	85
Schwartz Jool	3U 72
Schwenk Thomas I	72 29
Science education	06
Scranton, Ryan	67
Screaton, Gavin	4
Screening, whole body 1	84
Scullin, Matthew H 2	59
	44 25
Sea lions	95 1 1
	44 05
Seddon Nigel 3	58
Sefc. Kristina M.	16
Segal, Rosalind A 20	60
Seielstad, Mark 85, 2	12
Selenium 2	53
Self-assembly 3	24
Sellers, William R 12	23
Semilo John	535
Sensors 46 1	14 16
Serotonin 61 1	87
Sesame oil	44
Sesso, Howard D 3	74
Severe acute respiratory	
syndrome 333, 34	41
Sewage treatment 67, 3	02
Sex determination 13	32
sexual behavior 30, 35, 7	8,
Sovmour Pogor	50 70
Sharpe Richard	19 72
Shear MM Katherine	73 17
Shearer, Andy	53
Shepherd, Andrew 2	78
Sheppard, Scott	29
Shift workers	13

Russell, Bertrand..... 140

Rutter, Michael ..... 245

SCIENCE NEWS

Shih, Tom
Shinbrot, Troy
Shiratori, Semei
Shock Waves
Shirduel, Auridii M 204 Shynoss 20 373
Sigurdsson Steinn 19
Silicon
Silk
Silk, Joan B 181, 283
Silliman, Brian
Silver
Silveter, David J 357
Sinclair, Anthony
Sinddis Virus
Singer, Burton H
Slillid, PdWdll
Skin natches 3/1
Slabbekoorn. Hans
Sleep93, 173, 228, 238, 398
Sloan Digital Sky Survey 67,
Slotkin, Theodore A 310
Smart materials 157, 359
Smell
Smith, Andrew C 235
Smith, Derek
Smith Dotor U
Smith Pobort 202
Smith Shelley D 131
Smith Vernon 251
Smog
Smoke
Smoking 14
Smuts, Barbara
Snails
Snell, Howard L 212
Snoring 173
Snow, Allison
Snyder, D. Stephen 69
Snyder, D. Stephen 69 Snyder, Solomon H 22
Snyder, D. Stephen       69         Snyder, Solomon H.       22         Sobel, Noam       308         Social interactions       51
Snyder, D. Stephen
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H
Snyder, D. Stephen         69           Snyder, Solomon H
Snyder, D. Stephen         69           Snyder, Solomon H
Snyder, D. Stephen
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen
Snyder, D. Stephen
snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
snyder, D. Stephen
Snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
Snyder, D. Stephen
snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
snyder, D. Stephen
snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276,
snyder, D. Stephen
snyder, D. Stephen         69           Snyder, Solomon H.         22           Sobel, Noam         308           Social interactions         51, 276, 

Srivastava, Abhishek 153 St. Amand, Paul 232 Standard model 189
Stanford Linear Acceleratory
Stapelfeldt, Karl R
Stapleton, Heather 275
Starburst galaxies
Stardust mission 115
Stars 125, 134, 291, 382
Stars, evolution of 291
Statistics
Stein, C. Michael 388
Stellar winds 261
Stem cell factor
Stem cells
Stensmyr, Marcus C 379 Stents 214
Stereotypes
Steyaert, Louis T
Still, David L
Stock market
Stocker-Wörgötter, Elfie 110
Stoddart, Fraser
Stone Age 10, 277, 389
Stoneking, Mark
Strachan, Norval
Strange, Bryan A
Stratosphere
Stratton, Gall E
Strength 101
Stress
String theory
Strom, Stephen E
Strong force 245, 381
Strong, Don
Stucky, Galen D 69
Subramanian, Vivek 342
Subterrariean nies
Sugii, Nellie
Summers Anne 150
Sun
Sunder, Shyam 251
Sunderland, Trey 180
Superconductivity 229 324
Juper conductivity 227, 324
Superfluidity 229, 262, 324
Superfluidity 229, 262, 324 Supernovas 227, 261 Supernovas 227, 261
Superfluidity
Superfluidity 229, 262, 324 Supernovas 227, 261 Superparamagnetic limit 171 Suttle, Curtis
Superfluidity

lau protein 68, 1/9
Toflon 279
Tegmark Max 275 297
Telecommunications 190 218
Telomeres
Teng, Stacy 40
Terahertz radiation 358
Terjung, Ronald L 102
Termites 344
Ternes, Thomas A67
Ierracotta
Totor Marcus A
Tetrahedrons 93
Tetrahydrocannabinol 99
Thadhani, Ravi
Theise, Neil D
Thermodynamics
Théry, Clotilde
Thien, Leonard
Thin films 30, 91, 93
Thomas, Chris D 102, 310
Thomas, James H
Thompson, Lonnie G 216
Thorne, Peter
Thornton, Joseph 180
Thundat Thomas 116
Thymus 69
Thyroid 230 261
Thyrotropin
Tides
Tienari, Pekka 165
Tirrell, Matthew
Tissue-type plasminogen
activator 93
Titan 213
Tobacco
100n, Brian
Torros Cuillormo 270
Torres, Guillermo
Tour Jamos 192
Tour, James
Tour, James182Townsend, Timothy142Toxin, anthrax147
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35.
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,           232, 317         Transistors           Transplants         69           Transplants         69           Transportation         46           Trilobites         221
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James       182         Townsend, Timothy.       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James         182           Townsend, Timothy.         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy.         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James         182           Townsend, Timothy         142           Toxin, anthrax         147           Trace fossils         286           Transgenic plants         29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       317         Transplants       69         Transplants       69         Transportation       46         Trilobites       221 <i>Triceratops</i> 286         Trudeau, Vance L       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121
Tour, James       182         Townsend, Timothy.       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       Transplants         Transplants       69         Transplants       69         Triceratops       286         Triceratops       286         Trideatops       286         Trideatops       286         Truceatops       286         Trudeau, Vance L       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       121         Turon necrosis factor-alpha       366         Turgsten       158, 218         Turbulence       68         Turg, Alan M.       136         Turner, Michael S.       227
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       3324, 342         Transplants       69         Transplants       69         Transportation       46         Trilobites       221 <i>Triceratops</i> 286         Trideau, Vance L       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121         Turnor necrosis factor-alpha       366         Turngsten       158, 218         Turbulence       68         Turing, Alan M.       136         Turner, Michael S.       227         Tuveson, David       371
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       Transplants         Transplants       69         Transportation       46         Trilobites       221 <i>Triceratops</i> 286         Trites, Andrew W.       196         Trudeau, Vance L.       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121         Turnor necrosis factor-alpha       366         Turngsten       158, 218         Turbulence       68         Turng, Alan M.       136         Turner, Michael S.       227         Tuveson, David       371         Two Micron All Sky Survey       371
Tour, James       182         Townsend, Timothy.       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       Transplants         Transplants       69         Transplants       69         Triceratops       286         Triceratops       286         Trideatops       286         Trideatups       286         Trideau, Vance L       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121         Turon necrosis factor-alpha       366         Turgsten       158, 218         Turbulence       68         Turg, Alan M.       136         Turner, Michael S.       227         Two Micron All Sky Survey       307         Tyrannosaurus rex.       286         U       U         Lueshima, Rei       243
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317         Transistors       133, 324, 342         Transplants       69         Trate fossils       286         Transplants       69         Transportation       46         Trilobites       221 <i>Triceratops</i> 286         Trideau, Vance L       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121         Turnor necrosis factor-alpha       366         Turngsten       158, 218         Turbulence       68         Turing, Alan M.       136         Tureoson, David       371         Two Micron All Sky Survey       307 <i>Tyrannosaurus rex</i> 286         U       Uleris       333
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,         232, 317       Transplants         Transplants       69         Transplants       29         Trice tops       286         Triceratops       286         Trites, Andrew W.       196         Trudeau, Vance L.       302         Tseng, Hsian-Rong       182         Tuberculosis       349         Tucker, Brian       120         Tumasello, Joe       121         Turon necrosis factor-alpha       366         Turngsten       158, 218         Turbulence       68         Turner, Michael S       227         Tuveson, David       371         Two Micron All Sky Survey       307         Tyrannosaurus rex       286         Ulcers       333         Ultrasound       24, 86         Ultraviolet light       29, 302         Ulvestad, James S       40         Ulyses spacecraft       115         Underground fires       2415
Tour, James       182         Townsend, Timothy       142         Toxin, anthrax       147         Trace fossils       286         Transgenic plants       29, 35,

Universe, shape 296
Upper Paleolithic cultural
evolution
Uranus
Uric acid 254

#### V

Vaccines	. 4, 83, 147, 204
Vajda, Alan	
van der Waals f	orces 56
van Driel, Henn	y M 14
Van Gogh, Vinc	ent6
Van Hove, Joha	n L.K
Vandiver, Pame	la
VanItallie. Theo	dore B
Vascular endot	helial growth
factor	21
Veech Richard	1 376
Vela nulsar	L
Vontor I Craig	107 282
Vermiculite	
Vocikari Timo	205
Vesikari, mmu .	
Velivel	
Vile, Richard	
Vincent, Renau	a/3
VINIK, Aaron I.	
Vining, Elleen P	.G
Viruses	7, 45, 125,
	318, 356, 382
Vision 15	8, 234, 308, 331
Vitamin D	
Vogan, Kyle J	
Volcanoes	22, 94, 168, 211
Vortices	
Vrha Elisabeth	S 11

#### W

Wada, Shiro	326
Wagner, Sigurd	342
Waldor, Matthew K.	. 27
Walensky, Rochelle P.	348
Walker, Matthew P.	230
Wampold, Bruce E.	357
Wang, Julia Y.	147
Wang, Pao K.	388
Wang, Shen-ge	. 86
Wanty, Richard	264
Ward, Fred.	371
Ward, Richard L.	205
Waren Anders	291
Warrant, Eric J.	
Warwick, Suzanne	233
Waste hazardous	142
Water drinking	94
Water repellent	278
Watnick Paula I	293
Watts. David	283
Webb David	236
Wecker John	205
Weeds	317
Weeks leffrey	296
Weigel Detlef	314
Weinberg, Steven	107
Weis Christopher P	21
Weisshaar Terry A	362
Weissleder, Ralph	124
Wellenius, Gregory A.	. 73
Werker, Janet F.	237
Werner, Michael W.	387
Wertheimer, Michael R.	. 86
West, Jennifer	382
Wetlands	292
Whales	326
Whaley, K. Birgitta	262
White Nile	340
White, Edward V.	362
Whitehead, Hal	283
Whitehead, Lorne A	195
-	

Wilcox Sara	189
Wilczok Frank	245
Wildfiree	150
Wildlifes	156
Wiley, Haven	
WIIKIE, DAVID S	83
wilkinson Microwave	
Anisotropy Probe .	. 67, 296
Wilkinson, Gerald	284
Will, Clifford M	280
Williams, Kevin K	366
Williams, Stephen E	102
Wilson, James D	230
Wilson, Jeffrey A	262
Wind	397
Winemiller, Mark H	254
Wings, Oliver	286
Wofsy, Steven C.	118
Wolfe, Alexander P	198
Wolfers, Justin	
Wolfram, Stephen	106
Wolkow Catherine	75
Wolnert Lewis	188
Women	189
Wood Ken	20
Woodarz Dominik	106
Woodin Hugh	130
Woode David	120
Woods Cordon	130
Worm Poris	E0 0E
Wortman Camilla D	39, 63
Worthan, Carnine B	
Wright Drothers	
wright, waureen S	
wu, yvonne W	
wyss, warkus	102
X	

### 

Y chromosome
Yablonovitch, Eli 218
Yamada, Tadasu K 326
Yamamoto, Yoshiyuku 126
Yasukawa, Ken 202
Yeaman, Michael 54
Yeast
Yohay, Kaleb H 350
Yost, Joseph 188
Young, Mark 8
Ytterbium 285
Yuzvinsky, Tom 54

#### Ζ

Zahn, James6
Zaidi, Mone
Zebrafish 126
Zeigler, Anette-G 213
Zeki, Semir
Zeolites 142
Zerhouni, Elias A
Zettle, Alex
Zhang, Jianzhi
Zhang, Junfeng
Zhou, Qi
Zidovudine
Ziffer, Herman
Zimmer, Robert J 108
Zircon
Zitvogel, Laurence
Zohary, Ehud
Zoos
Zschokke, Samuel 141
Zuidema, Pieter A 390
Zwicki, Ron
. ,