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climate's genetic effect new view of ancient computer gene's breast cancer link hybrid butterfly

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cosmic confusion

PLANET, DWARF, STAR?

THE WEEKLY NEWSMAGAZINE OF SCIENCE



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Cover A brown dwarf star is surrounded in this illustration by a disk of dust and gas—a miniature solar system in the making. An infrared telescope recently spotted just such a disk around a brown dwarf. That sighting and similar recent observations have blurred distinctions among stars, brown dwarfs, and planets. (T. Pyle/Spitzer Science Center, JPL/NASA) Page 360

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SCIENCE NEWS This Week

Cancer Link

Gene regulates progesterone effect on breast cells

Since its discovery in 1994, the *BRCA1* gene has given up its secrets grudgingly. Early on, scientists recognized that it kept cancer at bay. Women carrying a mutation in

the gene face an extremely high risk of breast and ovarian cancer. Researchers have struggled to understand how the protein encoded by a normal *BRCA1* gene works.

A study in mice now suggests one possibility: The BRCA1 protein moderates the hormone progesterone's effect in breast cells. The protein appears to calm those cells when progesterone urges them to divide and grow.

Earlier research had shown

that BRCA1 protein orchestrates the repair of damaged DNA. But since that process occurs continuously in every cell throughout the body, the finding failed to explain how a mutated *BRCA1* would predispose a woman specifically to cancers of the breasts or ovaries.

In the new study, the researchers genetically engineered mice so that they didn't make BRCA1 protein. Breast tissue in these animals grew abnormally, creating many branching mammary ducts of a type usually seen only in pregnant mice, says Eva Y.-H.P. Lee, a molecular biologist at the University of California, Irvine.

Compared with normal breast cells, the breast cells in the genetically altered mice were also three times as likely to have progesterone receptors—proteins on the cell surface that serve as docks for the hormone. When progesterone binds to the receptor, it sends a signal that's transferred to the cell nucleus. Progesterone typically instructs a cell to proliferate.

Normally, after a progesterone receptor transmits a growth signal, the cell destroys the receptor, Lee says. However, animals lacking BRCA1 failed to complete this routine cleanup process, she and her colleagues report in the Dec. 1 *Science*. In some cases, other progesterone molecules bind to the already used receptor, generating more proliferation signals.

All the mice in a group bereft of BRCA1 protein developed tumors within 5 to 9 months, the researchers found. But when similar mice received the antiprogesterone drug mifepristone, they showed no cancer during the 12 months of observation.

The study "places the progesterone receptor right in the middle of the physiology" of BRCA1-related breast cancers, says physician Steven Narod of the University of Toronto.

"This provides compelling evidence that abnormal branching [in mammary glands] is due to aberrant progesterone signaling," says oncologist Nicholas Turner of the Breakthrough Breast Cancer Research Centre in London.

However, Narod notes that mice aren't a perfect model for the human disease because healthy women with *BRCA1* muta-

tions don't exhibit the abnormal duct branching seen in the animals in this study.

Antiprogesterone drugs might control abnormal signaling, thereby preventing or treating cancers in some women with the *BRCA1* mutation, says oncologist Eliot M. Rosen of Georgetown University in Washington, D.C. At present, "the most effective protection [against breast cancer for women with a *BRCA1* mutation] is drastic surgery to

remove the ovaries and both breasts," he says. An antiprogesterone "might be a non-surgical approach," he adds.

Narod cautions that determining the preventive effects of an antiprogesterone drug would require a massive clinical trial of healthy women. A test of an antiprogesterone as a treatment for breast cancer might come first, he says. -N. SEPPA

New Butterfly High-alpine species from low-life parents

Little bluish butterflies high in the Sierra Nevada mountains have an unusual history. Researchers report that these insects belong to one of the few animal species known to have arisen from crossbreeding of two other species.

Crossbreeding of animal species isn't unusual in itself, explains Zachariah Gompert of Texas State University in San Marcos. But the descendants of most hybrid offspring meld back into the parent species or don't compete successfully against the parental lines.

The not-yet-named butterflies in the *Lycaeides* genus, however, flourish in the harsh zone above the timberline, where the parent species can't cope, Gompert and his colleagues say. When they began studying the high-elevation butterflies, team members already suspected that two neighboring species had played some role in the high-living population's history.

The upper-alpine species shared some DNA variations with *Lycaeides idas* from wet meadows on the western slopes of the mountains, and it has wing patterns like those of *Lycaeides melissa* from the drier eastern slopes. All these butterflies belong to the genus studied by 20th-century novelist Vladimir Nabokov.

Gompert and his colleagues did extensive genetic work on the three Sierra Nevada species. The pattern of markers and sequenced genes best fit the scenario of the high-alpine lineage arising from the other two species and later following its own evo-



EFFICIENT HYBRIDS These two butterflies are members of a not-yet-named species that has colonized harsher habitats of the Sierra Nevada mountains than its parent species have.

Lifetime risk of breast cancer among women with a *BRCA1* mutation

STATS

SCIENCE NEWS This Week

lutionary path, the researchers say in a paper that *Science* has posted online.

Some new hybrid species arise with an increase in the number of chromosomes. However, the butterfly hybrid has the same number of chromosomes as its parents do, so some other barrier must prevent it from interbreeding with those species.

Not only does the hybrid survive in a different habitat, says Gompert, but the butterflies strongly prefer as host plants a specialized high-altitude *Astragalus* in the pea family. The parent species rely on other plants, such as alfalfa and lupines.

Moreover, the hybrid females have the unusual quirk of laying eggs on their host plant without glue, although the parent species use glue on their eggs. The eggs without glue quickly tumble off the plant, and that tumble protects the next generation. In winter, alpine gales blast away dried-up plants and any hitchhikers. However, eggs that fell to the ground hatch in spring near emerging shoots.

Botanists have already accepted the idea of this kind of hybrid species, such as some native sunflowers, says insect evolutionary ecologist Mark Scriber of Michigan State University in East Lansing. As zoologists, "we'd been brainwashed into thinking hybrids are dead ends," he says.

Yet recent research has revealed animal species that seem to have come from hybrids, including the unusual tiger swallowtail butterflies that Scriber studies in the Appalachian Mountains.

Biologists have also recently proposed hybrid speciation to explain a new *Rhagoletis* fruit-eating fly that has appeared on an invasive honeysuckle shrub. Other teams report that they have re-created a type of *Heliconius* butterfly by crossbreeding two related species in the lab (*SN: 6/17/06, p. 371*).

Hybrid species with the same chromosome number as their parent species "may be more common than we thought possible," Scriber says. —S. MILIUS

Howdy, Neighbors

Long-term study finds a batch of red dwarfs

The galactic neighborhood just got more crowded. Astronomers have found 20 previously unknown star systems that lie



THE STARS NEXT DOOR A pair of red dwarfs, dubbed SCR 0630-7643, shown in this artist's representation, is one of 20 newfound star systems that lie within 33 light-years of Earth.

within 33 light-years of Earth. All the stars are faint, low-mass objects called red dwarfs, which rank among the most prevalent stars in the Milky Way.

The team discovered the star systems— 2 triplets, 3 pairs, and 15 single stars—using a telescope at the Cerro Tololo Inter-American Observatory near La Serena, Chile. Since 1999, the astronomers have been monitoring hundreds of stars, looking for motions indicating that some might lie close to the solar system.

Todd Henry of Georgia State University in Atlanta and his colleagues describe their findings in the December *Astronomical Journal*.

The newfound neighbors offer fresh data on the frequency with which stars have partners, notes Henry. The growing census of nearby stars also provides new places to search for extrasolar planets.

"Red dwarf stars ... are the closest and most numerous stars to us, so they are the best places to look for planets," comments theorist Alan Boss of the Carnegie Institution of Washington (D.C.).

Nearby stars reveal their distances from Earth by tracing tiny ellipses in the sky—a consequence of Earth's orbit around the sun. The greater the apparent motion, the nearer the star. Henry's team has concentrated on red dwarfs, which range in size from about a tenth to half the mass of the sun. The dwarfs are among the dimmest stars and so have taken a long time to find.

Although astronomers have found several extrasolar planets orbiting red dwarfs, theorists had dismissed the possibility that any such planet could harbor life. Calculations indicated that a body warm enough to hold liquid water would have to lie so close to a red dwarf that the planet would be forced to rotate in sync with the star. One side would always face the star, and the other would face away, creating climates that would be either boiling hot or freezing cold. But models described by Boss and his colleagues in an upcoming *Astrobiology* paint a more optimistic picture. For instance, if such a planet were to have a thick atmosphere, it could redistribute heat from the star and possibly make both sides of the planet habitable.

In recent years, Henry's team has also found several near-Earth white dwarfs, which are old, sunlike stars, and failed stars called brown dwarfs. Henry told *Science News* that his team plans to report eight nearby star systems not mentioned in the current paper. —R. COWEN

A Toast to Healthy Hearts Wine compounds benefit blood vessels

Researchers have identified a class of compounds in red wine that might be responsible for much of the beverage's cardiovascular benefit. These compounds vary in concentration among wines grown in different areas and may explain some regional differences in wine drinkers' longevities.

Some researchers have suggested that the common practice of drinking red wine at meals could explain why life expectancy in France tops that in many countries where people eat lighter fare. Recent studies have suggested that people who consume a glass or two of red wine each day have healthier cardiovascular systems than those who don't imbibe.

However, these studies haven't identified components in the wine that might be responsible for these effects.

To find the active molecules, Alan Crozier of the University of Glasgow in Scotland and his colleagues worked with cells that

line the blood vessels of cows. These endothelial cells—and their counterparts in people—secrete a compound called endothelin-1 that constricts blood vessels. Overly narrowed blood vessels contribute to heart attacks and strokes, Crozier explains.

He and his team gathered more than 100 red wines from wine-making regions around the world. To learn which wines might inhibit endothelin-1 production, the researchers diluted the wines and added each solution to endothelial cells growing in laboratory dishes.

Crozier's group chemically analyzed the wines and found that the best endothelin-1 inhibitors had the highest concentrations of polymeric procyanidins, which are compounds among wine's tannins.

Wines with the highest concentrations of polymeric procyanidins tend to be grown and locally consumed in areas of southwestern France and the Italian island of Sardinia, Crozier notes. Remarkably, when he and his colleagues looked at census data for cities throughout France, they found that residents of the southwest tended to have the longest life spans.

Crozier's team reports these results in the Nov. 30 *Nature*.

The findings are "intriguing," says Matt Kaeberlein, who studies aging at the Uni-

versity of Washington in Seattle. He notes that polymeric procyanidins belong to a broad family of compounds called polyphenolics. Studies have suggested that polyphenolics can ease diabetes, obesity, and some neurological diseases.

Crozier's results are "another piece of evidence that polyphenolics have a lot of interesting properties," Kaeberlein says. However, he points out that the findings fall short of showing that polymeric procyanidins are solely responsible for red wine's cardiovascular benefits. Other components in the beverage's

complex chemical makeup may also play important roles.

"The only way we're going to figure out what's the ultimate benefit of compounds like this for humans is to CHEERS Red wines from southwest France and Sardinia, Italy, have a heavy dose of compounds called polymeric procyanidins. A new study indicates that these chemicals promote cardiovascular health.

get [the compounds] into clinical trials and see whether they have beneficial effects," Kaeberlein says.

His University of Washington colleague Peter Rabinovitch agrees, adding that health-conscious consumers shouldn't change their wine choices yet. However, since the traditional wine-making techniques still in use in southwestern France and Sardinia increase concentrations of polymeric procyanidins, he says, other vintners may soon adopt such methods.

"If I were a vintner interested in exploiting publicity given to the possible health benefits of these red wine components, I might consider evaluating my wine-making process," Rabinovitch says. —C. BROWNLEE

Lead in the Water Mapping gets a handle

on disinfectant's danger

In 1854, Dr. John Snow stopped a cholera outbreak in London by mapping the sick residents' homes and the locations of the city water pumps. Most people who had fallen ill, it turned out, lived near the Broad Street pump, which Snow would later discover delivered pathogen-tainted water. Snow removed the pump's handle, and the outbreak abated.

Health researchers are now using geographic data to understand a different waterborne threat: lead poisoning.

> Researchers in North Carolina have used a mapping program called a geographic information system (GIS) to investigate the link between lead-contaminated water and an increasingly common water disinfectant.

Municipal water systems add disinfectant chemicals such as chlorine to the water. However, byproducts of chlorine disinfection can be carcinogenic, so nearly a third of the nation's waterworks have switched to a disinfectant called chloramine.

In the past few years, officials in several U.S. cities—including Washington, D.C., and Durham and Greenville, N.C.—have discovered

lead contamination in drinking water after they switched to chloramine. Many researchers have assumed that those incidents were exceptions.

But some studies have suggested that chloramines in combination with other drinking-water additives may chemically release lead particles from the interior surfaces of plumbing.

To investigate, Marie Lynn Miranda and her colleagues at Duke University in Durham, analyzed data from Wayne County. In that county, the city of Goldsboro switched its water system from chlorine to chloramine in 2000.

The researchers used GIS software to link data on children's blood-lead concentrations, the age of each residential building, and areas where chloramine disinfection went into use. The age of a home could affect the lead content in tap water because older homes are more likely to have lead pipes or lead solder in the plumbing.

The scientists compared data from before and after Goldsboro switched from chlorine to chloramine disinfection.

"There was an increase in blood-lead levels in the period after chloramines were introduced," Miranda says. The magnitude of the increase depended on the age of the housing. Children living in homes built before 1965 experienced a greater increase in blood lead than children living in newer housing did, Miranda's team reports in an upcoming issue of *Environmental Health Perspectives*.

Miranda and others are cautious about extrapolating the finding to other cities and water-treatment systems, although they say that Wayne County's system is unexceptional.

Goldsboro has a relatively new water system, with few lead pipes but some leadsoldered joints. "This would be one of the last places where you'd expect to see any significant impact on blood lead from a switch [in disinfectants]," says Marc A. Edwards, an engineer at Virginia Polytechnic Institute in Blacksburg.

"The good news [is that the] increase in blood lead was of short duration and of relatively limited magnitude," says Edwards.

GIS studies of lead exposure are already under way in other cities, including Washington, D.C., Edwards says. —B. HARDER

Crusty Old Computer

New imaging techniques reveal construction of ancient marvel

Scientists say that they have figured out the arrangement and functions of nearly all the parts of a mysterious mechanical gadget that was discovered a century ago in a 2,000-year-old shipwreck.

Since it was found, the shoe-box-size device known as the Antikythera mechanism has amazed historians and other scholars with its advanced technology. The precision assembly contains 30 bronze gears with as many as 224 presumably hand-cut teeth.

Students of the mechanism, who have long known that it served as an astronomical computer, have deemed it to be at least 1,000 years more advanced than any other known mechanical device of its era. The remains of the apparatus consist of more than 80 congealed fragments of disintegrating metal adorned with cryptic inscriptions and encrusted with corrosion.

To make sense of that shattered structure, astronomer Michael G. Edmunds of



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Cardiff University in Wales and his colleagues have now applied two advanced imaging techniques to the shards. One is X-ray computer tomography, which records views of an object like those produced by a medical CT scanner. A highpower X-ray source penetrated the dense relic with a beam narrow enough to reveal fine details, says Andrew Ramsey, a tomography specialist with X-Tek Systems in Tring, England.

"The computer tomography images of the mechanism have literally opened the device up to us to see how it worked," comments ancient-astronomy scholar John M. Steele of the University of Durham in England.



THEN AND NOW Artist's rendering of the proposed internal machinery of an ancient astronomical computer (top) includes hands on upper- and lower-gear trains that rotated to track long-term astronomical cycles. Superimposed on fragments of the computer (bottom) is a reconstruction of a spiral dial for predicting solar and lunar eclipses.

The researchers also applied a novel computer-enhanced, optical-imaging technique for examining surface features.

Indeed, in the Nov. 30 *Nature*, the team of British, Greek, and American researchers reports that its fresh look at the mechanism has uncovered clear evidence of a previously suspected function: computing lunar and solar eclipses. The new images also doubled the number of inscriptions that could be read on the device's parts. The inscriptions indicated specific functions, not all of which had been known.

Furthermore, the work revealed a previously unrecognized lunar-motion feature, says filmmaker and mathematician Tony Freeth of Images First, a leader of the study.

The researchers used their new data to come up with a revised configuration for the machine's clockwork that uses 29 of the 30 known gears plus five hypothetical gears, four of which had been proposed previously by other researchers.

The new work is "an important advance," comments Michael T. Wright, an Antikythera-mechanism scholar and a retired curator of London's Science Museum.

In the issue of *Nature* containing the report, François Charette of Ludwig Maximilians University in Munich calls the model "highly seductive and convincing in all of its details."

Among such details is a proposed spiral dial at the lower-back section of the device. Around this dial, the motion of a hand indicates the solar and lunar eclipses during a period of 18 years. Wright adds that the Antikythera mechanism probably also employed long-lost ways to show the motions of planets. —P. WEISS

Stone Age Role Revolution

Modern humans may have divided labor to conquer

Chalk up modern humanity's rise and the extinction of Neandertals to a geographic accident. That's the implication of a new analysis of material from previously excavated Stone Age sites.

Homo sapiens evolved in Africa's resourcerich tropics. As a result, a division of labor arose beginning around 40,000 years ago that roughly corresponds to the arrangement found in most foraging societies today, say Steven L. Kuhn and Mary C. Stiner, both archaeologists at the University of Arizona in Tucson. Men in these societies hunt small and large game, while women and children gather tubers, berries, and other foods.

In contrast, Neandertals evolved in Europe and Asia, where large animals

were the most abundant food source. Kuhn and Stiner suspect that individuals of both sexes and all ages collaborated in hunting. The high risks of killing the large beasts kept Neandertals' numbers low, the researchers propose.

H. sapiens' switch to a division of labor for procuring different foods prompted population growth, the researchers say. As humans migrated north and the two species jockeyed for survival in the same areas, humans enjoyed a competitive advantage over Neandertals.

Kuhn and Stiner say that humans' survival at Neandertals' expense hinged not on being uniquely clever, as many scientists have assumed, but on a fortunate social structure. Their investigation appears in the December *Current Anthropology*.

Kuhn and Stiner reviewed evidence from well-excavated Neandertal and modernhuman sites in Italy, Israel, and Turkey dating mainly between 100,000 and 10,000 years ago. Neandertals lived from around 250,000 to 30,000 years ago.

Before 45,000 years ago, large- and medium-size game—including gazelles, deer, and wild horses—account for virtually all the animal remains and potential food sources at most locations. Large game declined slightly in importance—to about 80 percent of all prey—beginning around 45,000 years ago. The decline appeared primarily at modern-human sites.

Kuhn and Stiner then determined that the range and amount of small game increased dramatically after 45,000 years ago at modern-human sites. Such prey included birds, rabbits, and fish. Furthermore, many of these sites contain evidence of elaborate clothing and specialized artifacts, including sewing implements likely used by women.

After 15,000 years ago, following Neandertals' extinction, the importance of large game dropped sharply—to about 30 percent of all prey—and evidence of plant foods became more prominent.

Kuhn and Stiner suggest that men and women first adopted specific social roles in tropical African regions where modern *H. sapiens* originated. However, scientists have examined only a handful of such sites.

Archaeologist John J. Shea of the State University of New York at Stony Brook regards Kuhn and Stiner's argument as a "reasonable hypothesis." Still, he cautions, much is unknown about the extent to which modern-human and Neandertal behavior varied from one region to another.

Archaeologist Olga Soffer of the University of Illinois at Urbana-Champaign remains unconvinced. Kuhn and Stiner underestimate Neandertals' reliance on small game such as turtles and birds, and men and women alike may have used sewing implements to mend clothes, she says. —B. BOWER

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WHAT'S A PLANET?

New riddles beyond the solar system

BY RON COWEN

found a planet!" Caltech astronomer Mike Brown remembers exclaiming during a phone call he made to his wife early in 2005. Little did he know that he'd have to eat his words just 18 months later. Brown had found an outer-solar system object heavier than Pluto, so it seemed reasonable to call the object the tenth planet.

But last August, the International Astronomical Union approved the first formal definition of a planet since the Greeks coined the

term some 2,000 years ago. Pluto, got the boot, and Brown's proposed tenth planet, a body now called Eris, was disqualified.

The group of astronomers decided to call Pluto and Eris "dwarf planets"—a class that the scientists say is separate from the solar system's eight official planets. That decision remains controversial, although many astronomers say that there's merit in the demotion. Both Pluto and Eris are considerably smaller than the first eight planets discovered. These two orbs ought to be grouped with the swarm of other icy objects in the Kuiper belt, a region beyond Neptune that may contain millions of such bodies, Brown says.

Although Pluto's planethood is etched in cultural memory—and on lunch boxes, on postage stamps, and in textbooks—knowledge about the solar system has skyrocketed since the body's discovery in 1930.

"The new definition essentially corrects an astronomical mistake from 76 years ago and shows that astronomy can move forward in the face of new information about the which some researchers call planemos, may even have a planetary-mass object orbiting it.

The discoveries are blurring the line between planets and stars and may bring about a revolution in thinking about planets that goes far beyond the Pluto debate.

OLD THEORIES, NEW DATA In the good old days, circa 1990, stars were stars and planets were planets. For the most part, astronomers accepted that stars arose from the gravitational collapse of giant clouds of gas. They shined by fusing hydrogen nuclei into heavier elements.

Planets, on the other hand, arose from disks of gas and dust surrounding stars. In the most popular theory, planets were



CONUNDRUM — Astronomers have photographed one of the smallest objects (arrow) ever found orbiting an ordinary star beyond the solar system. Circling the young red dwarf star CHXR 73, the body weighs in at about 10 times the mass of Jupiter, small enough to be a planet but big enough to be a failed star called a brown dwarf.

solar system," Brown wrote recently on his blog (*http://www.gps. caltech.edu/~mbrown/eightplanets/*). But even as scientists and the public grapple with Pluto's demotion, new findings from beyond the solar system are eroding the meaning of *planet*.

Over the past few years, astronomers have found several extrasolar objects that by weight would qualify as planets, yet they lack what would seem to be the most basic of planetary prerequisites—a parent star. Many of these free-floating orphans are surrounded by disks of dust and gas with enough mass to coalesce into their own miniature solar systems. One of the orphans, the discovery of these massive orbs, several researchers, including Gibor Basri of the University of California, Berkeley, were finding dwarfs with lower and lower masses. Inevitably, note Basri and Brown in the 2006 *Annual Review of Earth and Planetary Science*, extrasolar planets and brown dwarfs became harder to tell apart. About 5 years ago, astronomers began finding objects in Jupiter's mass range that weren't orbiting anything (*SN: 5/19/01, p. 312*).

"Astronomers and planetary scientists were forced to admit that they didn't really have a clear-cut definition of 'planet,'" Basri and Brown say.

spawned by bits of material in the disks gradually coalescing into larger and larger objects. In a competing scenario, sections of the disk suddenly fragmented, forming planets wholesale. In either case, planets orbited their parent stars and weren't massive enough to trigger hydrogen fusion.

But in the early 1990s, researchers discovered the first hybrid objects failed stars known as brown dwarfs. These bodies, theorized to form as stars do, tip the scales at up to 75 times the mass of Jupiter, the most massive planet in the solar system.

Although the minimum mass of a brown dwarf remains controversial, some researchers peg it at 13 Jupiter masses. That's hefty enough to initiate fusion but not to sustain it. After these failed stars stop that process, they spend the remainder of eternity cooling.

The discovery of planets that orbit sunlike stars further muddied the standard picture of planet formation. For starters, many of these extrasolar planets are several times as heavy as Jupiter. Also, around the time of **PUZZLING FINDINGS** "The fact is there is ambiguity ... and this ambiguity will be with us for a while," says theorist Adam Burrows of the University of Arizona in Tucson.

Consider, for instance, the star HD 3651, which is slightly less massive than the sun and just 36 light-years from Earth. By measuring the back-and-forth motion of this star, astronomers deduced several years ago that HD 3651 hosts a planet smaller than Saturn that whips around the star in a close, 62-day orbit. Now astronomers have directly imaged a much more distant object orbiting HD 3651. The new find is one of the faintest and coolest brown dwarfs ever discovered close to Earth. The object lies about 1,500 times farther from HD 3651 than the star's planet does.

The image of HD 3651 demonstrates for the first time that brown

dwarfs and planets can form around the same star-perhaps in the same way-notes Markus Mugrauer of the University of Jena in Germany. He and his colleagues describe their findings, from several groundbased telescopes, in an upcoming Monthly Notices of the Royal Astronomical Society. Another team, led by Kevin Luhman of Penn State University in State College and using NASA's orbiting Spitzer Space Telescope, describes its study of HD 3651 in an upcoming Astrophysical Journal.

In separate work, reported in the Oct. 1 *Astrophysical Journal*, Luhman and his colleagues used the Hubble Space Telescope to photograph an object, about 10 Jupiter masses, orbit-



TWO IN ONE — A brown dwarf (large red object in main image) circles the star HD 3651 (faint point of light in both images) in an extremely distant orbit, in this artist's depiction. Inset shows that the star also has a Saturn-mass planet orbiting it closely.

It might be that planet formation proceeds at different rates and in different ways at different distances from stars, says extrasolar-planet hunter Ray Jayawardhana of the University of Toronto. Moreover, determining just how little mass an object can have and still qualify as a star provides critical information about the history of star formation throughout the universe.

RIDDLE RESOLUTIONS Given the shifting definition of stars and planets, what are astronomers to do?

Basri and Brown each suggests a different way out of the planetary puzzle. Basri proposes lumping together all objects massive enough to have ever undergone nuclear fusion—whether they did so for less than a million years as a brown dwarf or billions of years

> as a sunlike star. He would call all such objects fusors, which he maintains are fundamentally different from objects that never had enough mass to fuse nuclei.

> Basri would call the lowermass objects planemos. Only those planemos that orbit a fusor would be considered planets.

> Brown, Luhman, and some other astronomers prefer to categorize objects on the basis of how they formed, not how big they are. A low-mass object would qualify as a planet only if it formed from a gas-anddust disk surrounding a star, even a brown dwarf.

> There's a hint that nature itself distinguishes objects on the basis of how they form, Brown says. The universe appears to have

ing the star CHXR 73. The orbiting object's mass alone would typically identify it as a heavy planet spawned from a disk that once surrounded this young star.

However, the newfound object lies about five times as far from CHXR 73 as Pluto's average distance from the sun. Theory suggests that a gas-and-dust disk isn't likely to contain enough material that far from a star to make a planet. "Although the object seems to be [of] planetary mass, we argue that it's not a planetary companion, just a very small brown dwarf companion," says Luhman.

Distinguishing between brown dwarfs and planets is important, says Luhman. A brown dwarf could have its own retinue of planets, which astronomers could search for. In contrast, a planet at such a great distance from its parent star would most likely be a loner.

In a report presented in August at the meeting of the International Astronomical Union in Prague, researchers suggested that brown dwarfs might form in a different manner from both stars and planets. According to the new hypothesis, brown dwarfs are much smaller than bona fide stars because a dwarf arises from the sudden fragmentation of a ring or disk of material surrounding a pair of brand new stars.

Planets might also arise in this manner, but the fragmentation of a large disk surrounding two stars favors the formation of a brown dwarf, according to study coauthor Greg Laughlin of the University of California, Santa Cruz.

In many cases, the stellar pair kicks away the new dwarf but doesn't give the body enough oomph to escape a surrounding cluster of stars. That would account for the multitude of brown dwarf loners found in young stellar clusters, such as the Orion star-forming region. In other cases, the dwarf remains in orbit around the two stars. Laughlin, Doug Lin, also at Santa Cruz, and Ing-Guey Jiang of the Central University of Taiwan recently posted their ideas online (*http://xxx.lanl.gov/abs/astro-ph/0610814*). separate methods and locations for forming star companions, depending on their mass. Within the immediate neighborhood of a star—a few times the Earth-sun distance—orbiting objects tend to be either less than five or more than 60 times Jupiter's mass.

The gap in mass suggests that nature has two distinct ways to make an object that will orbit a star, Jayawardhana notes. One mechanism, the traditional planet-formation scenario, may dominate at low masses, while another, which tends to make brown dwarfs, may dominate at high masses.

Determining how an object formed, however, is a daunting task, notes Luhman. Telescopes take snapshots but not movies following a body back in time to its origin.

Using the proposed successor to Hubble, the James Webb Space Telescope, as well as sharpened optics soon to be installed on the ground-based Gemini North and South telescopes, astronomers hope to determine whether planets exist farther away from stars' neighborhoods. This may provide additional clues about planet formation. The sharper resolution will also give astronomers a chance to directly glimpse extrasolar planets like those in our own solar system.

"At some level, I don't' really care" what people call planets and stars, says Jayawardhana. "To me, the main sort of motivation and fascination with this business ... is that we've learned in the last couple of years that nature seems to be able to make planetary-mass objects in more than one way." He adds, "We haven't figured out details of the story, but it's saying something really fundamental" about the universe.

For now, Burrows suggests that astronomers hold back on a rigid definition of planet. "People just want ... to name things or to stuff objects into cubbyholes," he says. "I prefer a bit of ambiguity to the illusion of clarity and the pretense of certainty. When there is fog, to acknowledge its presence is more honest than to try to ignore it."

INHERIT THE WARMER WIND

Some organisms' genes are changing in step with Earth's climate

BY CHRISTEN BROWNLEE

hile Christina Holzapfel and William Bradshaw were post-doctoral fellows at Harvard University, they discovered a love for each other—and for bogs. The pair used to spend entire days knee-deep in peat, admiring the soupy, muddy scenery. "It's a peculiarity, I know," says Holzapfel. "But when you see the pitcher plants in bloom, with these exquisite pink blossoms shining out over the generally mucky mess, it's a stunning thing."

Now, 30 years later, Holzapfel and Bradshaw are married and jointly running a lab at the University of Oregon in Eugene. The couple's attention focuses on one of a bog's typical residents—a tiny mosquito that makes its home inside carnivorous pitcher

plants. This pitcher plant mosquito (*Wyeomyia smithii*) helps itself to insects captured by the plant, digesting parts of the bugs and leaving the rest behind for the plant.

Much of the two scientists' work revolves around a phenomenon known as photoperiodicity, in which the mosquitoes rely on day length to determine when to go dormant in the fall. Variations in this trait are controlled by genes. Five years ago, the two scientists got their first clues that the *W. smithii* specimens they'd analyzed while at Harvard weren't quite the same as the ones they continue to capture and study today.

Other researchers had already observed that global warming seemed to be changing the actions of some organisms (*SN: 3/8/03, p. 152*)—animals from birds to butterflies were migrating out of their long-time habitats, and plants were flowering too early or going dormant too late. Some scientists had batted around

the idea that not all these changes were superficial—that instead, populations might be responding to global warming by modifying their genes.

Holzapfel and Bradshaw remembered that idea one morning over coffee as they flipped through the decades of data they'd collected on photoperiodicity in *W. smithii.* "We were totally shocked by what we saw," recalls Holzapfel. Photoperiodic time tables, hardwired in the mosquitoes during thousands of years of evolution, appeared to be gradually changing in many of the populations—a result, the two scientists say, of warmer temperatures in each population's habitat.

Holzapfel and Bradshaw's mosquitoes were one of the first organisms in which scientists observed genetic changes that might be attributed to global warming. Other scientists have more recently reported that the genetic makeup of organisms ranging from fruit flies to birds might also be responding to climate trends. Although these adaptations may enable some animals to keep pace with global warming, animals that don't evolve quickly could be at risk.

A BUG'S LIFE It makes sense that insects would be among the first animals to show signs of genetic change in response to global warming, says Bradshaw. Many insect species have survived climate swings and other environmental changes that have taken place in the past few hundred thousand years. This suggests that in some bug populations, genomes contain enough variety to adapt to changes.

Furthermore, insects are fast and prolific breeders. So, a few individuals with a gene variation that helps them survive an environmental change can quickly spread the novel trait throughout the population.

Bradshaw explains that in W. smithii, an appropriate photope-

riodicity is pivotal for an individual insect's survival. Go dormant too early in the fall, and the mosquitoes don't have enough energy stored to survive the winter; wait too long to go dormant, and the insects could freeze to death.

Since day length is the same in a particular location year after year, but differs from place to place, mosquitoes in individual locales throughout the pitcher plants' range—from north Florida up to Manitoba, and from Nova Scotia across to Minnesota—have evolved separate photoperiodic clocks to regulate their life cycles. These clocks are so location specific that Bradshaw and Holzapfel have relied on them to check where a bug came from.

"When we brought animals into the lab, we would measure their response to day length just to be sure we were working with what we thought we were working with," says Holzapfel.

In 2001, the pair reported its evidence

that global warming has warped some mosquito populations' responses to day length. Holzapfel and Bradshaw had analyzed data that they'd collected from experiments between 1972 and 1996, in which they'd placed insects collected from different places in tiny compartments stacked in a big cabinet—"mosquito Hiltons," says Holzapfel. Each compartment had an air-cooled light that turned on and off to simulate a different day length.

The researchers found that the mosquitoes' responses to light evident in their development and dormancy patterns—differed significantly among bugs collected in northern and southern locations in 1972. However, by 1996, many of the northern populations were acting more like their southern counterparts. The most prob-

 SPRING FORWARD — Genetic variation within

populations of the great tit (pictured) could keep hatch times in step with the springtime appearance of caterpillars, which the birds use to feed their hatchlings.

able explanation for this change, says Bradshaw, is that global warming has extended the growing season for northern mosquitoes. With warmer winters, the bugs have more time to grow without going dormant.

Other research teams have seen a similar northern-southern merge in the genes of fruit flies. George W. Gilchrist, who studies a fruit fly species known as *Drosophila subobscura*, notes that

researchers have long been fascinated by a peculiar genetic quirk in this and some other fruit fly species. Small sections of these insects' chromosomes are reversed in some individuals but not in others.

"It's like pieces of a bar code that are flipped backward," says Gilchrist.

Though it's not clear what these chromosomal inversions do for the insects, researchers have noticed that the reversals follow a pattern: Wild fruit flies at the same latitude tend to have similar patterns of inversions, with the patterns shifting in a gradient extending northward from the equator. Some researchers have hypothesized that these inversions may permit fruit flies to survive in particular climates.

In the Sept. 22 *Science*, Gilchrist and his colleagues published evidence that these inversion patterns in fruit flies on three continents—Europe, North America, and South America—have changed in response to climate. When the researchers compared chromosomal data taken in the late 1970s and the early 1980s with recent data, they found that fruit flies living at latitudes farther from the equator have gradually changed to resemble those living near the equator.

"Almost every site sampled is warmer now than it was before the chromosomes now look like the chromosome patterns from a slightly warmer place," says Gilchrist.

EARLY BIRDS Researchers aren't seeing genetic changes just in fast breeders such as insects. Some studies suggest that populations of animals that take years to breed are also beginning to show genetic responses to climate change.

Stan Boutin of the University of Alberta in Edmonton and his colleagues have kept track of individuals in a red squirrel colony in the southern Yukon for 15 years. "They're a pretty rare mammal, in that you can follow them right from birth through their entire lives," he says. That's because the squirrels are territorial, so Boutin and other researchers can easily track individuals year after year. The squirrels eat only one food, spruce seeds, so Boutin's team can document how much each animal consumes. Also, these animals reproduce in grass nests that are easy to spot in trees. Researchers can see when females give birth, count the number of offspring, and tag them.

"It's like living in a town where no one ever leaves, and you have birth certificates for all of them," he says. Indeed, Boutin and his colleagues have developed an extensive pedigree for the animals.

Combining this information with the characteristics of individuals in the colony, Boutin and his colleagues in 2002 spotted some traits that seem to be controlled genetically. Most notably, mothers who give birth early pass on that tendency to their daughters.

Because of today's warmer spring temperatures, the trees produce more cones than they did a decade ago. Over the past 10 years, Boutin says, the animals' birth dates have advanced, on average, about 18 days—enabling them to take advantage of the larger spring boom of spruce cones.

Boutin notes that since the size of the cone crop varies significantly

from year to year, even without global warming's effects, colonies of red squirrels probably harbor gene variants that prompt some moms each year to give birth at the most advantageous time.

"The population may be genetically preadapted to cope with the rapid climate change that we're seeing," he says.

Some bird populations also seem to harbor genes that may similarly help them cope with global warming. Although great

tits may have the genetic potential to adjust to conditions that come with warmer temperatures, they haven't made that adjustment yet, notes Daniel Nussey of the University of Cambridge in England.

The birds rely on a food chain that's been skewed in recent years by global warming, Nussey says. Trees are budding earlier, causing an earlier springtime boom in caterpillars that use the buds for food. Great tits, in turn, harvest these spring caterpillars to feed their babies. However, the great tits haven't altered their laying schedule to keep up with the caterpillars.

"What you have here is an emerging mismatch between levels in the food chain that's driven by climate change," says Nussey. "There's no evidence of negative consequences yet, but you can see that there could be a major problem if it goes on."

If the birds stick to their age-old laying schedule while the caterpillar boom shifts earlier, then they won't have enough food for their babies, he explains. Much like Boutin's red squirrels, indi-

vidual great tits are easy to track, says

Nussey. In one great tit population that researchers have studied for 50 years, the birds nest in a series of human-made boxes in a forest in the Netherlands. Scientists can peek inside a box to see when each female has laid the first egg of her clutch, check when the eggs have hatched, and eventually catch and tag the offspring. With these methods, researchers have compiled a pedigree for the colony that stretches back several decades.

Using this pedigree, Nussey and his colleagues reported in the Oct. 14, 2005 *Science* that the birds' laying habits appear to have a genetic basis. Mothers who lay early tend to pass on that trait to their daughters. The researchers also found that females that lay early have more offspring that reenter the population as adults to breed than do females that lay later.

If this trend continues, says Nussey, birds that lay early might replace those that lay later—correcting the mismatch between the caterpillar boom and the hatching of the birds' offspring.

SURVIVOR As global warming has progressed and led to further ripples of environmental change, says Nussey, some researchers predict widespread die-offs of many species. However, he notes that his work and that of others is showing that at least some species may adjust to these changes.

"The message from our study is actually quite positive about climate change. If animals have the evolutionary potential and can change their responses, then this could potentially rectify some of the problems" associated with global warming, Nussey says.

However, it's unlikely that every species possesses this intrinsic capability to adapt, says Camille Parmesan of the University of Texas in Austin. Parmesan, who studies adaptation to climate change in a variety of butterfly species, adds that a population must have both the right genetic variations and a breeding period that's not too long to keep pace with global warming.



squirrels like this one have advanced an average

of 18 days over the last 10 years. This may be so

they can take advantage of the spring boom of

spruce seeds, which has grown in recent years

presumably because of global warming.



PITCHER UP — Northern populations of the pitcher plant mosquito (pictured) now respond to day length more like southern populations of the insect, presumably because of warmer temperatures in higher latitudes.

The species that are already being negatively affected by climate change probably don't have these traits, she explains.

"The [species] we thought would be most sensitive—the mountaintop species and corals—they haven't evolved. They just died," Parmesan says. She adds that there's no evidence so far that longlived creatures, such as polar bears and penguins, in climates drastically affected by global warming are adapting to the changing conditions.

It's impossible to predict how the presence or absence of such evolution could ultimately change ecological communities, says Bradshaw. "We won't recognize communities—they'll be different," he says. "Is different bad or good? Different is different. Whether it's bad or good depends on your point of view."

As global warming continues, some organisms will probably die out and some will stay—but life will go on, adds Holzapfel.

"We are hopeful people, hopeful that adjustments will be made so the world will keep going," she says. "I'm hoping that *W. smithii* is one of the ones that stick around." ■



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OF NOTE

NANOTECHNOLOGY Safety practices surveyed

As companies and laboratories work with nanotechnology, they largely rely on the same safety practices that they use when working with conventional chemicals, a survey reports.

There are no regulations or voluntary standards for operations using nanomaterials. In the United States, the National Institute of Occupational Safety and Health has provided general guidance on handling the materials, notes Kristen Kulinowski, director of the International Council on Nanotechnology at Rice University in Houston, which released the survey results Nov. 13.

Sixty-four companies, research organizations, and universities from the United States, Europe, Asia, and Australia responded to the survey. Overall, the organizations expressed concern that nanomaterials carry special risks. But with little risk information, says Kulinowski, organizations must derive safety practices "from knowledge they've gained of materials of the same chemical composition but in a larger form.

"The question is whether nanoscale materials warrant any additional information, scrutiny, tests, or personal protective equipment," adds Kulinowski. "Right now, we don't have the answers for that." —A.C.

Oceans reveal secrets of viruses

Earth teems with bacteria-eating viruses. There are perhaps 10 times as many of these viruses as of all other living things put together. Yet researchers don't know how many virus species there are, how they are distributed around the globe, or how diverse their genes are. Now, a team of scientists has begun to answer those questions, completing the first survey of virus DNA in oceans around the world.

Scientists knew that each milliliter of ocean water holds about 50 million virus

particles and that those organisms kill 20 percent of the bacteria in the ocean every day (*SN: 7/12/2003, p. 26*). In the process, viruses move gene sequences from one bacterium to another, speeding evolution and turning some bacteria virulent.

Curtis Suttle of the University of British Columbia in Vancouver began collecting samples of ocean water from around the world in 1998. He saved them, waiting for genomic sequencing to become inexpensive enough to reveal the genes of all the viruses in the water at once.

That time finally came. Suttle, Forest Rohwer of San Diego State University, and several colleagues analyzed 1,300 samples of ocean water from the Arctic, British Columbia's coast, the Gulf of Mexico, and the Sargasso Sea. They report in the November *PLoS Biology* that 91 percent of the DNA sequences in the water were previously unknown.

The DNA sequences suggest that each area of the ocean contains its own characteristic community of viruses. The researchers were surprised to find that many viruses found in the Sargasso Sea have a single strand of DNA rather than the typical two strands. Such viruses had never previously been found in the ocean. —J.J.R.

TREATMENT

Belated angioplasty saves no lives

A common heart procedure doesn't save lives if it is performed more than a couple of days after a heart attack, according to a large international clinical trial.

The procedure, angioplasty, has been found to offer benefits when it's done within 48 hours of a heart attack (*SN*: 6/25/05, p. 413). In angioplasty, doctors force open a blocked heart artery by inserting and inflating a tiny balloon.

Nearly one-third of heart attack patients don't realize what's happening to them and so get no treatment within the 2-day timeframe, says Judith S. Hochman of New York University, who led the new study. In that group, doctors typically still administer drugs and often perform angioplasty once the heart attack is diagnosed. "Until this trial was completed, we didn't know they were getting unnecessary [angioplasty] procedures," Hochman says.

She and her colleagues studied 2,166 heart attack patients. All were given standard drug therapy, which usually includes

MEETINGS

American Heart Association Chicago, III. November 12 – 15

administering aspirin and pills containing beta-blockers, during the period between 2 and 28 days, and on average 8 days, after the attack. The researchers then randomly selected half of the patients to receive angioplasty.

After 3 years, rates of death, recurrence of heart attack, and development of severe heart failure were not significantly different between the two groups, Hochman reported. -B.H.

IMPLANTABLE DEFIBRILLATORS Test identifies people at cardiac risk

Measurement of an electrical abnormality in the heart aids doctors in determining who is most at risk for cardiac arrest, according to a new study.

Computers can detect the abnormality, called T-wave alternans, during an electrocardiogram, a recording of the heart's electrical activity. Since T-wave alternans often precedes sudden cardiac arrest, researchers have suggested that it could be used to decide which patients need implanted defibrillators (*SN: 9/23/06, p. 202*). Those devices sit inside the chest and deliver a therapeutic shock when the heart needs it. However, many patients get defibrillators unnecessarily.

Now, doctors have completed the first systematic test of using T-wave alternans for making decisions about implanting defibrillators. David S. Rosenbaum of Case Western Reserve University's Metro-Health Campus in Cleveland and his collaborators made the measurement on 566 heart patients. The doctors implanted defibrillators in all 401 volunteers who had abnormal T-wave patterns, but they opted not to use devices in the remaining volunteers unless other tests overwhelmingly indicated the need.

Over 1 year, patients with the abnormal T-wave patterns were about twice as likely as other patients to have a cardiac event that necessitated a defibrillator.

T-wave testing combined with other tests could reduce unnecessary use of defibrillators by as much as 40 percent, Rosenbaum says. -B.H.

MEETINGS

TOXICOLOGY Could Prozac muscle out mussels?

New research raises the possibility that antidepressant drugs may be depressing wild-mussel populations.

Freshwater mussel communities are declining in U.S. waters for reasons that remain poorly understood. Scientists at North Carolina State University in Raleigh wondered about a possible antidepressant link after another research team showed that pregnant zebra mussels, if they're exposed to extra serotonin, release nonviable larvae. Serotonin is the brain chemical boosted by antidepressant drugs such as fluoxetine, the active ingredient in Prozac.

Sewage-treatment plants fail to completely remove fluoxetine and most other drugs, which then can pollute U.S. waters (*SN: 6/17/00, p. 388*).

To test the vulnerability of wild mussels to these drugs, the North Carolina researchers collected pregnant females of the native–U.S. species *Elliptio complanata*. Working with Rebecca Heltsley of the National Institute of Standards and Technology in Charleston, S.C., the scientists exposed the mussels to various concentrations of fluoxetine in the lab. All mussels released their larvae within a day.

Moms exposed to 300 micrograms per liter or more of the drug—much higher concentrations than are observed in the wild—released few young that survived. Adult-female mussels incubated at concentrations closer to those found in U.S. waters produced mostly viable young.

The findings don't necessarily mean that U.S. waters are safe for the shellfish, Heltsley says. Mussels and other animals in the wild are exposed to pollutants for long periods, whereas the experiment was brief, she points out. Moreover, she adds, wild mussels may encounter more than one serotonin-enhancing pollutant, and the various drugs' effects could be additive. —J.R.

ENVIRONMENT Sharks, dolphins store pollutants

Flame-retardant chemicals have become ubiquitous in the environment. A new study finds that in Florida's top saltwater predators, such as sharks, concentrations of these contaminants and other persistent industrial chemicals are high and increasing rapidly. Society of Environmental Toxicology and Chemistry Montreal, Quebec, November 6 – 9

Researchers at the State University of New York at Albany and the Florida Fish and Wildlife Conservation Commission in Melbourne teamed up to measure flame retardants called polybrominated diphenyl ethers (PBDEs) and the electric-insulation compounds known as polychlorinated biphenyls (PCBs). The scientists tested coastal-Florida fish and marine mammals.

Fat from prey fish such as perch contained on average about 43 parts per billion (ppb) of PBDEs. Shark species, however, averaged 750 ppb in their fat, and dolphins had 1,190 ppb. A few bull sharks and dolphins were contaminated with PBDE concentrations as high as 4,200 ppb. In various lab animals, these chemicals have impaired hormonal and reproductive function and disrupted fetal development.

PCB concentrations in the top predators were even more dramatic. Sharks had an average concentration of 25,800 ppb in their fat, and researchers found 162,000 ppb in the blubber of bottlenose dolphins. These values are "especially concerning," says Douglas H. Adams of the Florida wildlife agency.

Most troubling, the researchers say, is that their calculations suggest that PBDE and PCB concentrations are doubling every 2 to 4 years in bull sharks and bottlenose dolphins. —J.R.

ENDOCRINOLOGY No-stick chemicals can mimic estrogen

Preliminary data indicate that some of the compounds used to keep water from soaking into raincoats, grease from sopping through microwave-popcorn bags, and foods from sticking to cookware have another notable attribute: They can act like estrogen, the primary female-sex hormone.

Recent studies have shown that traces of these ubiquitous coatings, called perfluorinated compounds, regularly turn up in foods and even in human blood.

A research team from Oregon State University in Corvallis injected male and female juvenile trout with any of 36 perfluorinated compounds. Four of the compounds, including a common one known as PFOA, triggered the fish to make vitellogenin, a protein normally produced only by female animals during egg laying. At that time, they have high estrogen concentrations in their bodies. To probe how the compounds might mimic estrogen, the researchers did lab tests to see whether the four compounds bind to estrogen receptors, the cellular switches that are activated by the hormone. The four apparent estrogen mimics indeed bound to the receptors, but so did many of the other perfluorinated chemicals. These included another common nonstick-coating ingredient called PFOS.

Team member Abby D. Benninghoff concludes that the perfluorinated chemicals such as PFOS might be biologically active if administered through a different, more natural route of exposure. Alternatively, these chemicals might bind to the estrogen receptor and block the hormone from its site of action, she notes. —J.R.

ENVIRONMENT Leaden swan song

Since 1999, more than 2,100 trumpeter swans in northwest Washington and southwest British Columbia have died about 15 percent of the birds that winter in this region. Nearly 80 percent of the deaths occurred because the birds ate lead shotgun pellets, reports a U.S.–Canadian team of researchers.

Some 25,000 trumpeter swans breed in this region and other North American areas along the Pacific, notes team member Laurie Wilson, a wildlife biologist with Environment Canada in Delta, British Columbia. Over the past several decades, these swans have been climbing back from the brink of extinction, so the high death rate from lead poisoning is especially troubling.

To date, the team has autopsied more than 1,700 carcasses. "We're recovering, on average, 22 lead pellets" per bird, says Wilson. However, she adds, more than 4 percent of the birds had gizzards containing at least 100 pellets; a few had 600 or more there.

Blood samples collected from 250 birds migrating to the region showed that the birds flew in carrying low amounts of lead. That suggests that the area contains lead hotspots that are poisoning foraging birds, say Wilson and her colleagues.

Although lead shot has been banned from waterfowl hunting in this region for more than a decade, the researchers have identified several foraging sites where old lead pellets are still abundant in soil.

"These birds need grit for digestion," Wilson notes, "and the shot sizes we're finding in them are very similar to other grit that these birds select." If wildlife ecologists can identify more lead-shot hotspots, she says, the next goal will be to remove or bury the toxic shot in those locations. -J.R.

Books

A selection of new and notable books of scientific interest

SPACE 50 PIERS BIZONY

In just half a century, people have managed to explore the heavens in a way that ancient people never imagined. The space age dawned in 1957 with



the launch of the Russian spacecraft Sputnik 1. Since then, people have been to the moon and back, sent space probes to Mars and Saturn, and constructed an international space station. Science writer Bizony looks back on space exploration and ponders its future. He details the

rivalry between the two ingenious rocket scientists Sergei Pavlovich Korolev and Wernher von Braun, who paved the way for the intense space race between Russia and the United States. Since NASA's formation in 1958, U.S. citizens have been enamored of the idea of space flight. Political pressure after Russia's successful launch of a man into space spurred the U.S. government to catch up. Bizony chronicles the subsequent missions launched by both the United States and Russia. The author also explains some of the problems that have plagued NASA since its inception. Finally, Bizony examines whether the future of space travel lies in vessels designed by private companies and paid for by space tourists. HarperCollins, 2006, 320 p., color photos, hardcover, \$40.00.

MEALS TO COME: A History of the Future of Food WARREN BELASCO

With an ever-expanding world population facing an increasingly imperiled environment, what does the future hold for food production and consumption? Belasco, a professor of American studies at the Uni-



versity of Maryland, looks to the history of food production for clues about its future. He examines ethnic and economic influences on the consumption of animal products and the preference for meat over grain-based cuisines. He recounts past food predicaments, including the inflation of food prices, the

inequitable distribution of food surpluses, and Cold War jitters about the appeal of communism to malnourished people. He writes that the West's preference for wheat over other grains such as rice and rye is misplaced, that such foods have different environmental as well as nutritional impacts, and that many non-Westerners live well without luxury foods. He looks at utopian and dystopian models of the future of food. In so doing, the author outlines three prevailing views: classic, which posits that a steady expansion of civilization will lead to an equilibrium between traditional food supplies and population; modernist, which predicts that technology will create food such as the science fiction standard meal-in-a-pill; and recombinant, which combines elements of the classic and modernist

approaches to create both palatable organic foods and so-called functional foods marketed for their health benefits. *Univ. Calif. Press, 2006, 358 p., b&w images, paperback, \$21.95.*

DARK COSMOS: In Search of Our Universe's Missing Mass and Energy DAN HOOPER

Amazingly, only 5 percent of the matter in the universe is observable as Earth, other planets, the sun, the stars, and debris. All the rest is invisible, perhaps

DARK CUSMON IN SEARCH IF INI UNIVERSE'S MISSING MASS TAND ENERGY DAN HOOPER

composed of dark matter surrounded by dark energy. The search for these two elements is the fundamental task facing astrophysicists today, writes Hooper, a theoretical astrophysicist. He introduces readers to this search, defining what scientists know about the nature of dark matter and introducing can-

didate hiding places known as massive compact halo objects (MACHOs). Scientists infer the existence of these dark objects on the basis of their gravitational effects on visible objects in space. However, they also know that MACHOs alone wouldn't account for all dark matter, so some researchers have nominated neutrinos, other exotic particles, and even more-bizarre, extra-dimensional strings as dark matter candidates. The author then outlines the difficult notion of dark energy, a phenomenon that could explain the expanding universe and determine its fate. *HarperCollins, 2006, 240 p., b&w illus., hardcover, \$24.95.*

IS PLUTO A PLANET? A Historical Journey through the Solar System DAVID A. WEINTRAUB

The discovery of various large objects in the outer solar system has called into question the definition of a planet. In August, an astronomers' group answered the question posed in the title of Weintraub's book with a controversial "no." Weintraub, a



professor of astronomy, reviews the notion of planet. To ancient observers, planets were considered wandering stars because they appeared to rise and set in an otherwise fixed sky. Aristotle established an Earth-centered view of the universe that made the sun, the moon, Mercury, Venus. Mars. Jupiter, and Saturn

the original seven planets. Nicolas Copernicus in 1515 observed that Earth revolves around the sun, not vice versa. Johannes Kepler defined a planet as an object that revolves around the sun in accordance with his three laws of planetary motion. The number of planets would be in flux throughout the 18th century, culminating in the discovery of Uranus in 1781. Pluto was declared a planet in 1930. In the 1940s, Gerald Kuiper asserted the existence of a solar system reservoir of materials left over from the formation of the planets. During the late 1990s and early 2000s, astronomers discovered hundreds of objects there, some of which were large enough to rival Pluto. Weintraub describes astronomers' current attempts to reconcile these objects with the definition of a planet, including the creation of planet subsets. Finally, he provides an appendix with information about the now-demoted planet Pluto. Princeton, 2007, 254 p., b&w images, hardcover, \$27.95.

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LETTERS

Concerns vented

"Venting Concerns: Exploring and protecting deep-sea communities" (*SN: 10/7/06,* p. 232) barely scratches the surface of the problem. What is stopping someone from gene splicing the disease of choice onto heat-loving bacterium? Something that can live near the 600°F of melting lead will certainly survive the standard hospital-sterilization process.

D.J. KAVA, BEAUMONT, TEXAS

The statement "2 tons of ore from ocean sites should yield as much copper as 80 million tons of material mined on land" can't be correct. That's 40 million to 1. No one mines that kind of ore. **TERRENCE KERWIN.** SILVERTON. COLO.

The statement should have been that 9 m

The statement should have been that 2 million tons of ocean ore would yield that much copper. —J. RALOFF

Eruption deduction

In the article "Hot, Hotter, Hot: Climate seesawed during dinosaur age" (*SN*: 10/7/06, p. 228), the explanation for the increased ocean-surface temperature seemed to focus solely on atmospheric effects. I wonder if variations in undersea volcanism might have contributed to the sudden spike in Pacific Ocean surface temperatures during the Aptian epoch of the Cretaceous period. If so, then a moderately higher release of volcanic ash might have contributed to the sudden drop in ocean-surface temperatures.

DARRYLE VAUGHT, SELMER, TENN.

Say no to drugs

In the study that was cited in "Life Blood: Drug stops mothers' bleeding after births" (*SN: 10/14/06, p. 243*), misoprostol was tested as a more practical means of inducing postdelivery contractions in women in developing countries, despite "troubling side effects." Because most women need no intervention to cause the uterus to contract, why not wait a few minutes to see which of them will require the medication, instead of subjecting every single one of them to "severe shivering and fever"? **DIAN DUCHIN REED**, SOQUEL, CALIF.

Where drugs may not be available, why not use the natural approach to curb postpartum bleeding, namely, encourage breast-feeding? A baby's suckling stimulates the mother's flow of natural oxytocin. Low tech perhaps, but the methodology has been working for millennia. **VIRGIL H. SOULE**, FREDERICK, MD.

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