

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

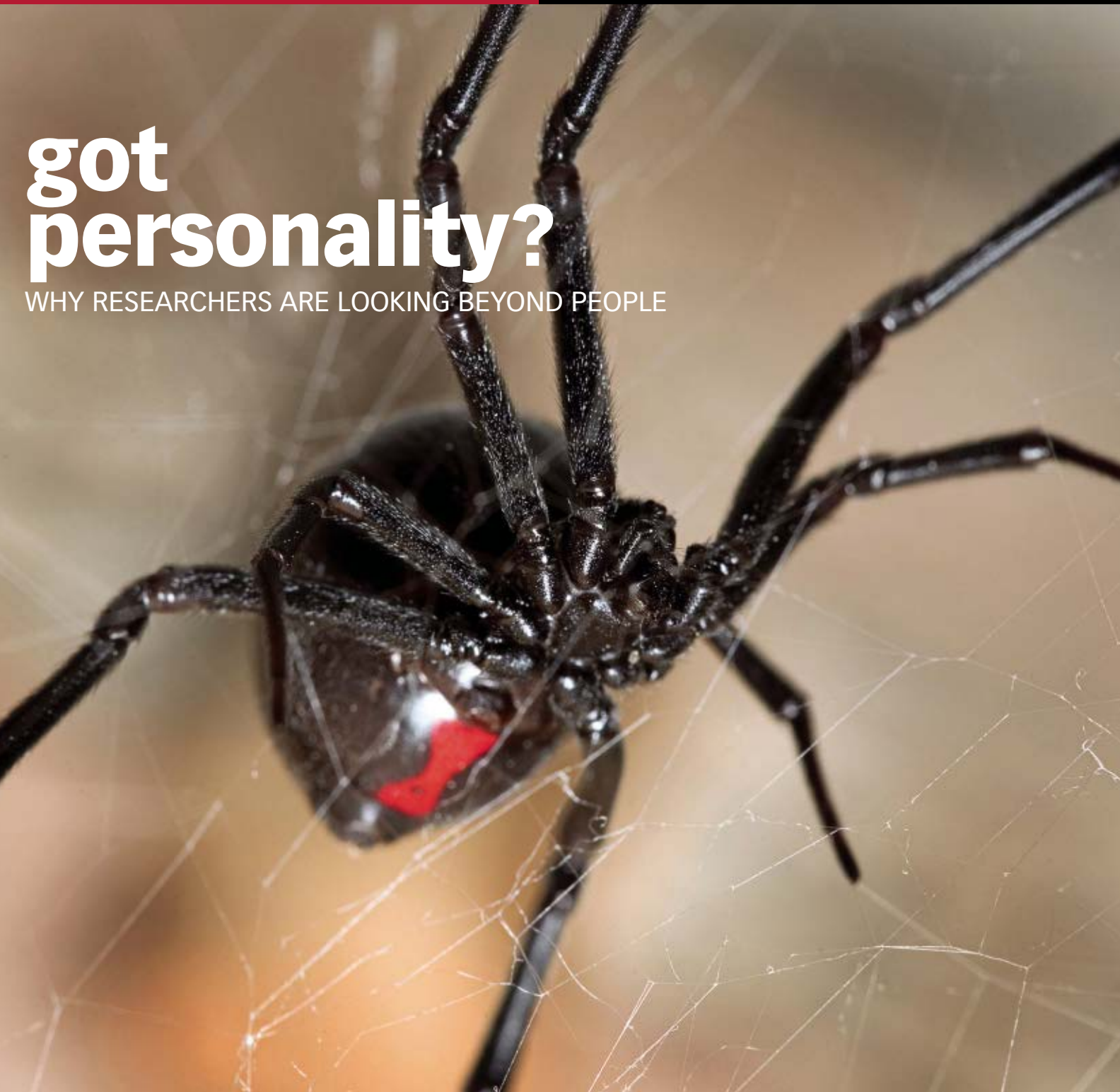
JANUARY 5, 2008 PAGES 1-16 VOL. 173, NO. 1

whales' modest beginnings
two faces of estrogen
malaria drug wards off cancer
stars' dark matter start

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got personality?

WHY RESEARCHERS ARE LOOKING BEYOND PEOPLE



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New Task

Malaria drug might inhibit some cancers

In the 1970s and 1980s, researchers in Tanzania distributed millions of doses of chloroquine to children as part of a 5-year malaria-prevention project. While the study yielded only mixed results against that disease, the researchers noticed a striking drop in cases of Burkitt's lymphoma, a blood cancer.

New studies in mice show that chloro-

quine may indeed prevent Burkitt's lymphoma and also a rare disease called ataxia telangiectasia that can lead to leukemia.

Burkitt's lymphoma is a cancer of B lymphocytes. A hyperactive version of a gene called *myc* turns these white blood cells malignant. The downward spiral typically begins with DNA damage that is not properly repaired. That leads to movement of DNA sections, including the *myc* gene, to unfamiliar locations on a chromosome, which can result in *myc* overactivation.

The protein that *myc* encodes, when superabundant, incites B lymphocytes to replicate out of control, Michael B. Kastan, a pediatric oncologist at St. Jude Children's Research Hospital in Memphis, Tenn., and his colleagues report in the January *Journal of Clinical Investigation*.

Spurred by *myc* proteins, proliferating cells maintain a nutrient supply by hijacking a natural cell-housekeeping process called autophagy, in which cells chop up and dispose of damaged or obsolete cell components such as proteins. Autophagy also comes in handy during famine or other stressful times, recycling processed compounds as nutrients to keep the cell going.

Burkitt's lymphoma cells, which have

voracious appetites, commandeer the process to accommodate their growth needs, says Kastan.

Enter chloroquine, which targets cancerous cells that make excess *myc* protein and stalls autophagy in those cells. In experiments on mice with a hyperactive *myc* gene—a model of Burkitt's lymphoma—animals given chloroquine survived 265 days on average, while mice without it lived 98 days.

A precancerous sign of Burkitt's lymphoma is a soaring white blood cell count. Kastan and his team found that just three doses of chloroquine normalized such counts that were starting to rise in young mice.

However, mice allowed to develop full-blown lymphoma before receiving chloroquine didn't benefit from the drug. The scientists found that chloroquine works only in the presence of a functional tumor-suppressing protein called p53. Established tumors can get the upper hand on p53 and silence the gene that encodes it.

Taken together, the findings suggest how mass distribution of chloroquine in Tanzania may have prevented many Burkitt's lymphoma cases, Kastan and his team conclude.

But the p53 findings raise doubts that the drug will help against established cases,

LETTER FROM THE PUBLISHER

Dear Reader of *Science News*:

I am proud to give you the scoop on some "science news": Science Service next week becomes Society for Science & the Public (SSP).

The nonprofit organization Science Service was founded in 1921 to provide more and better information about the burgeoning world of scientific discovery. *Science News*—initially a mimeographed sheet known as *The Science News-Letter*—was the vehicle for disseminating news of research developments, initially to newspapers, then as a magazine available to the public by subscription.

In subsequent decades, both the magazine and the organization have grown. Science Service, in partnership with the Westinghouse Corporation, launched the Science Talent Search in 1942. Now the famous Intel Science Talent Search, our flagship education program is the world's premier competition for high school seniors, whose alumni have won countless honors, including six Nobel prizes.

Under the leadership of Board Chair and Nobel laureate Dudley Herschbach, the organization determined that after nearly 9 decades it was time to reflect again on how we can serve our mission even more effectively. A distinguished volunteer commission of leaders in science, education, publishing, and management, chaired by former National Academy of Sciences President Bruce Alberts, examined the venerable organization's strengths and opportunities. The core of its findings was that now, more than ever, the voice of science must be heard clearly in public discourse. The first step is to adopt a new name that announces our purpose to advance public engagement in science.

SSP will continue to provide the "science services" that have earned the organization respect and renown for nearly 90 years. This includes a redoubling of our dedication to the excellence of *Science*



SOCIETY FOR
SCIENCE & THE PUBLIC

News. To that end, we are working diligently to enhance *Science News* so that it continues to produce brief, credible news on a broad range of science in ways that attract

an even greater audience. Our Editor in Chief, Tom Siegfried, and I are confident that the "new *Science News*" will reinforce your enthusiasm for the magazine, and that *SN* will continue to be an essential vehicle to carry out SSP's mandate to inform, educate, inspire.

—ELIZABETH MARINCOLA
PRESIDENT, SOCIETY FOR SCIENCE & THE PUBLIC
PUBLISHER, *SCIENCE NEWS*

Science News wins independent press award

Each week, this magazine distills "the latest trends and findings in the ever-expanding world of science into must-know information." Those aren't our words, but part of the explanation that the *Utne Reader* offered for naming *Science News* its winner, this year, as the premier source for "smart" and "accessible" science-and-tech coverage.

For 2 decades, the *Utne Reader* (and more recently, its Web site) has gained renown for offering a digest of news and independent ideas from a broad range of outlets. For grist, it claims to scout material each month from some 1,500 "cutting-edge publications"—many of which, like *Science News*, "you won't find at the average bookstore or newsstand."

To see what other kind words their awards committee had for us in their January/February 2008 issue, go to *Utne's* Web site (www.utne.com/2008-01-01/GreatWriting/Winners-of-the-2007-Utne-Independent-Press-Awards.aspx?page=8).

says Glen Brubaker, a public health physician at IMA World Health, based in New Windsor, Md. Brubaker, who coauthored the original Tanzania study, says the new report is surprising nevertheless. “Maybe we missed the direct effect of chloroquine.”

Since the *myc* gene has been implicated in at least 40 percent of cancers, several groups are now investigating chloroquine’s effect on various malignancies.

The new findings suggest that chloroquine might prevent cancer in people with premalignant or genetic conditions that predispose them to cancer, says Chi V. Dang, a hematology oncologist at the Johns Hopkins School of Medicine in Baltimore. Also, cancer patients who have undergone surgery to remove a tumor often remain at risk of recurrence, and chloroquine might benefit them, he speculates. “It’s a thing of beauty to discover new applications for old drugs,” Dang says. —NATHAN SEPPA

Plowing the Ancient Seas

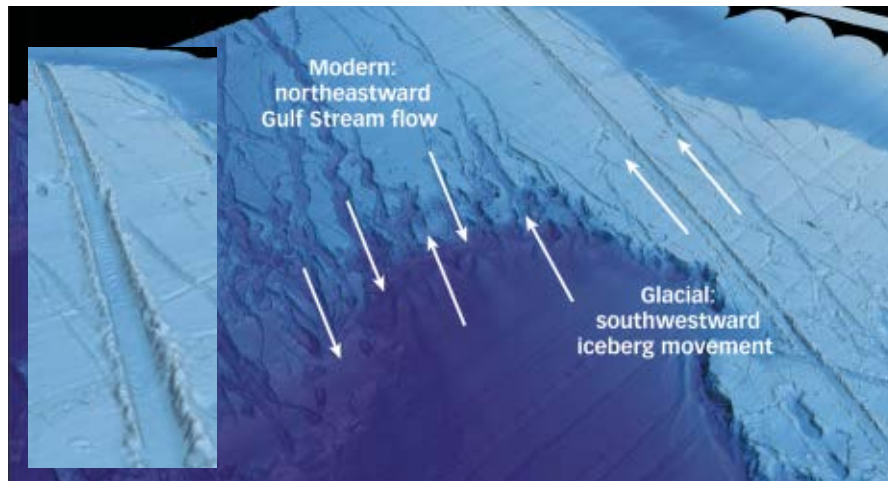
Iceberg scours found off South Carolina

Recent sonar surveys off the southeastern coast of the United States have detected dozens of broad furrows on the seafloor—trenches that were carved by icebergs during the last ice age, researchers suggest.

The channels, roughly parallel to the coast, are between 10 and 100 meters wide and typically less than 10 m deep, says Jenna C. Hill, an oceanographer at Coastal Carolina University in Conway, S.C. She and her team discovered the enigmatic features while conducting oceanographic surveys about 100 kilometers off Georgetown, S.C., in the summer of 2006. Waters in the area range between 170 and 220 m deep, she notes.

Most of the trenches run along straight paths for several kilometers, and one lengthy furrow stretches almost 20 km. Short berms alongside each groove are presumably composed of material that was plowed aside when the channels were carved, says Hill.

The seafloor features generally run in a southwest–northeast direction. However, the researchers noticed that some of the channels they discovered during a second survey last summer ended with a semicircular pit at their southwestern terminus. Suddenly, says Hill, the features made



FLOW REVERSAL Currents driving the icebergs that scoured channels in the seafloor off South Carolina at the height of the last ice age ran almost exactly opposite to today’s prevailing currents. Channel shown in inset is about 100 meters wide.

sense: Icebergs had plowed the furrows, and pits marked the sites where the ice masses became grounded and later melted.

The seafloor culs-de-sac indicate that the currents driving the icebergs flowed to the southwest, opposite to prevailing currents today. At present, warm waters of the northeast-flowing Gulf Stream bathe the region, says Hill. However, she and her colleagues suggest that an offshore shift in the Gulf Stream at the height of the last ice age—when sea levels were more than 100 m lower than they are now—would have allowed glacially fed, iceberg-rich coastal currents to penetrate this far south. Hill and her colleagues presented their findings last month in San Francisco at a meeting of the American Geophysical Union.

The team’s theory “makes dynamical sense,” says John M. Bane, Jr., an oceanographer at the University of North Carolina at Chapel Hill. Even today, he says, a seafloor feature about 100 km southwest of the berg-scoured region—a broad area called the Charleston Bump—can cause instabilities in the Gulf Stream that deflect the current offshore for a few weeks at a time, causing reversals in the coastal current. At the height of the last ice age, when sea levels were substantially lower, the Gulf Stream may have been more frequently, if not permanently, deflected offshore. —SID PERKINS

Twinkle, Twinkle

Dark matter may have lit up first stars

The earliest stars in the universe might have been beasts of a different nature than modern stars, a new model suggests. While nuclear reactions between ordinary chem-

ical elements fuel the fire of stars like Earth’s own sun, mysterious dark matter might have powered the first stars.

In the standard account of star formation, clouds of hydrogen and helium become unstable and start to cool and condense into small protostars. Shrinking under their own gravity, protostars eventually become dense and hot, and their atoms begin to fuse. This ongoing fusion reaction is the power behind starlight.

Katherine Freese and her collaborators, though, point out that this model doesn’t necessarily take all the parts of the early universe into account. About 85 percent of the matter in the universe is thought to be of an invisible or dark form, which scientists can detect only indirectly.

“You’ve got this whole reservoir of dark matter sitting out there too. It must play some role in stars,” says Freese, of the University of Michigan in Ann Arbor.

So she, along with Paolo Gondolo of the University of Utah in Salt Lake City and Douglas Spolyar of the University of California, Santa Cruz, created a model of what would happen to star formation if lots of dark matter got caught up in dense clouds of hydrogen and helium. Although the nature of dark matter is not known, the researchers made standard assumptions about the kind of particles of which it probably consists. The model predicts that the dark matter particles would interact among themselves, undergoing annihilation reactions that would create immense amounts of heat. This outpouring of energy would keep the helium and hydrogen from cooling and condensing.

“You get this heat source that prevents you from getting fusion, and you get stuck in this new place,” explains Freese, who says this phase could go on for as long as 600 million years. Eventually, though, the dark matter would run out, since every time two dark matter particles interacted, they would turn

HILL ET AL.

into ordinary matter. Then the helium and hydrogen could spawn protostars that would enter the standard fusion-powered stage.

Objects in this newly hypothesized phase of star evolution have been dubbed dark stars but the researchers say that the name, which comes from a Grateful Dead song, is misleading. "They'd actually give off lots of light," says Freese, "although we're not sure exactly what that light would look like."

For ultimate validation of their idea, the researchers hope the next generation of powerful telescopes will actually detect the dark stars, which could be 10 times as large as the solar system.

Until then, some scientists remain unconvinced. The new calculations shed light on one way dark matter may have interacted in the early universe, says Dan Hooper of Fermi National Accelerator Laboratory in Batavia, Ill. But he says the calculations, which appeared in the Dec. 27 *Physical Review Letters*, rely on many assumptions.

"A lot of it is speculative," says Hooper. "We don't know that stars in the early universe were forming under these particular conditions."

If these environments did exist, though, Hooper says dark stars could have existed. "It's not implausible by any means," he says. —SARAH C. WILLIAMS

Damage Control

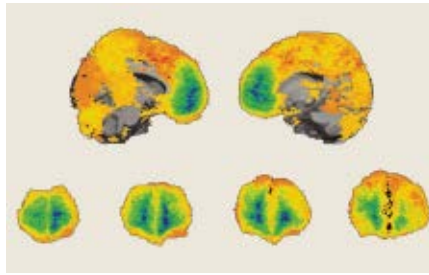
Brain injuries fight off PTSD in vets

Brain damage suffered while fighting in a war can undermine core aspects of a soldier's personality and behavior. In two particular neural regions, however, such wounds actually protect combat veterans against developing the severe stress reaction known as post-traumatic stress disorder (PTSD), a new study finds.

These brain structures play crucial roles in causing PTSD after exposure to traumatic experiences, concludes a team led by neuroscientist Michael Koenigs of the National Institute of Neurological Disorders and Stroke (NINDS) in Bethesda, Md.

Psychiatrists classify PTSD as an anxiety disorder characterized by frequent re-experiencing of a traumatic event, emotional numbing, avoidance of reminders of the upsetting event, and excessive vigilance. Previous brain-imaging studies had suggested that PTSD involves overactivation of the amygdala, a structure that mediates fear responses, as a result of reduced activity in the ventromedial prefrontal cortex, an area that tamps down emotional reactions. The same studies also implicated deficient activity in the hippocampus, a

memory-related structure, in PTSD. Still, it wasn't clear whether these brain alterations caused PTSD or resulted from it.



PROTECTIVE HARM Brain images use the colors blue and green to denote damaged parts of the prefrontal cortex (top) and the amygdala (bottom), linked to low rates of PTSD.

The new study, slated to appear in the February *Nature Neuroscience*, looked for neural causes of the stress disorder by probing PTSD development in interviews with 193 Vietnam combat veterans who had experienced various types of brain damage as well as traumatic war events. Another 52 combat vets in the study had no brain injuries.

Magnetic resonance imaging produced detailed images of participants' brain structure.

Consistent with previous studies, Koenigs' team found that none of the 15 vets with amygdala damage developed PTSD after their injury. PTSD emerged in only 7 of 40 vets with ventromedial pre-

frontal cortex damage, conflicting with earlier evidence that inactivity in this area promotes PTSD. The ventromedial prefrontal cortex apparently interacts with the amygdala in more complex ways than scientists have suspected, the researchers say.

Other anxiety disorders, such as panic disorder, occurred among these vets at rates typical of the general population.

In contrast, PTSD occurred in 40 percent of vets with other types of brain damage and in nearly half of those without brain damage.

Hippocampus damage showed no link to PTSD development in any group of combat vets.

"It appears that the amygdala and the ventromedial prefrontal cortex are necessary for PTSD to develop, whereas any hippocampus changes are probably responses to having PTSD," says study coauthor Jordan Grafman, also of NINDS.

Treatments that selectively disturb activity in either of the two critical brain regions may assist in easing PTSD symptoms, Grafman proposes. One way researchers might accomplish this feat would be by using a device that delivers harmless magnetic pulses to precise neural locations.

Psychologist Lisa M. Shin of Tufts University in Medford, Mass., calls the new study "important and thought provoking."

It's not yet clear why vets with ventromedial prefrontal cortex damage displayed low, not high, PTSD rates, she says. —BRUCE BOWER



Whales started small

The ancestors of whales, some of which are the largest creatures ever to evolve, were probably mammals no larger than a fox. New fossils of *Indohyus*, a genus previously known only from some teeth and a jawbone fragment, led researchers to identify these deerlike creatures as the closest known relatives of primitive whales. Certain features of the animals' skulls and earbones match those of whales and their close relatives but no other mammals, says Hans Thewissen, a paleontologist at the Northeastern Ohio Universities College of Medicine in Rootstown. *Indohyus'* bones are thicker than average for an animal its size, a buoyancy-stifling characteristic that would have enabled it to live partly underwater. *Indohyus* lived about 48 million years ago in southern Asia, Thewissen and his colleagues report in the Dec. 20/27 *Nature*. —SID PERKINS

Reading the Repeats

Cells transcribe telomere DNA

TTAGGG, TTAGGG, TTAGGG, TTAGGG. That's the piece of the genetic code repeated thousands of times in telomeres, the protective caps on the ends of chromosomes. Now, two groups of scientists have independently discovered that human cells transcribe this seemingly meaningless pattern into RNA molecules, a finding that could have implications for understanding cancer and aging.

Scientists have thought that telomeres merely protect chromosome ends from fraying and other damage, much like the plastic tips on shoelaces. Often, transcribing the genetic information encoded in DNA into matching RNA molecules is the first step in making a protein based on the gene. There seemed to be little reason for cells to transcribe the repetitive DNA in telomeres.

But Maria Blasco and Stefan Schoeftner of the Spanish National Cancer Center in Madrid found telomeric RNA in cells from people, mice, and zebra fish, the team reports online and in an upcoming *Nature Cell Biology*. The presence of telomeric repeat-containing RNA (TERRA for short) in such distantly related species suggests that telomere transcription is common among vertebrates.

Joachim Lingner of the Swiss Institute for Experimental Cancer Research in Epalinges, Switzerland, and his colleagues first reported the discovery of TERRAs in rat and human cells in the Nov. 2 *Science*.

Telomeres are thought to play an important role in aging. Each time most cells in a person's body divide, their telomeres get slightly truncated. This shortening is analogous to a burning fuse. Once telomeres get too short, the cells can no longer divide and soon die.

Immortal cell lines such as tumor cells and stem cells can keep dividing indefinitely because they have an enzyme, called telomerase, that lengthens telomeres.

The discovery of TERRAs raises questions about the molecules' influence on telomeres and cell immortality. "The evidence that telomere transcription's going to be a really interesting phenomenon to pursue is extremely high," comments Woodring E. Wright, a telomere expert at

the University of Texas Southwestern Medical Center at Dallas.

The two studies do offer early indications of the functional roles that TERRAs might play. Both teams observed that TERRAs bind to the proteins that package telomeres into a compact form. And in experiments with isolated molecules, Blasco's team showed that TERRAs inhibit the activity of telomerase, suggesting that TERRAs might impede the lengthening of telomeres within a cell. —PATRICK BARRY

Addiction Alleviator?

Hallucinogen's popularity grows

The unsanctioned use of an obscure drug to treat addiction has exploded recently, a new report finds.

A subculture of advocates who say the hallucinogen ibogaine alleviates addiction to opiates has welled up from New York City and spread to small clinics and informal treatment networks across the globe.

"On the basis of word of mouth, the ibogaine scene has quadrupled in the last 5 years," says Ken Alper, a psychiatrist at the New York University School of Medicine in New York City. Alper and two colleagues published their report in the January *Journal of Ethnopharmacology*.

Alper delved into the ibogaine culture by scanning an e-mail list and making contact with key proponents. In 2001, he reported that 857 people had taken ibogaine. In the new paper, Alper and colleagues report that by 2006, at least 3,414 individuals—and perhaps as many as 4,900—had taken ibogaine. Of these, 68 percent explicitly took it to treat addiction, mostly to heroin and other opiates, including prescription drugs such as OxyContin (oxycodone).

About 1,200 of the users obtained ibogaine from what Alper calls "lay providers/guides." Usually former addicts themselves, these providers have no formal medical training but often follow a treatment manual written by ibogaine advocates.

Ibogaine is illegal in the United States but legal in most of the rest of the world, including in Mexico and Canada, which together house at least three small ibogaine clinics.

Derived from the root bark of a West African shrub, ibogaine transports many users on an often unpleasant 24- to 36-hour "trip" in which they see visions or relive past events. Practitioners of the West African Bwiti religion ritually eat the root bark as a spiritual aid.

In 1962, a young heroin addict from Staten Island, Howard Lotsof, took ibogaine on a lark. After his trip, he no longer

craved heroin. Convinced of the drug's effectiveness against addiction, Lotsof, who worked on the new report with Alper, began trying to develop ibogaine into a legitimate medicine, a goal he continues to pursue despite numerous setbacks.

The National Institute on Drug Abuse (NIDA) in Bethesda, Md., invested several million dollars in laboratory and animal studies in the early 1990s before abandoning ibogaine.

In 1993, a physician from the University of Miami, Deborah Mash, won Food and Drug Administration approval for a human safety study of ibogaine. Mash never finished that study, but in 1996 she opened a clinic on the Caribbean island of St. Kitt's, where she has treated some 400 patients. In 2001, Mash published data on 32 of those patients, finding that ibogaine banished withdrawal symptoms.

One ongoing study, funded by the private Multidisciplinary Association for Psychedelic Studies in Ben Lomond, Calif., is tracking 20 patients treated at a Vancouver clinic. But a large, rigorous trial of ibogaine's long-term effectiveness seems unlikely.

"The idea of trying to push this into pharmaceutical development is a tough nut," says Frank Vocci, director of anti-addiction drug development at NIDA.

Vocci cites safety concerns as one reason for such reluctance. The new study reports that since 1990, 11 people have died within 72 hours of taking ibogaine. Ibogaine providers recommend that people with certain heart conditions avoid the drug, as it can exacerbate those problems.

Still, Alper says that studying ibogaine could provide basic insights into addiction. "Ibogaine has its limitations, and it may or may not be something that's practically useful, but the mechanism of action of ibogaine and why it's working is a really, really interesting scientific question." —BRIAN VASTAG



UNDERGROUND A growing number of heroin addicts use ibogaine, a hallucinogen derived from the shrub *Tabernanthe iboga*, seen here, to ease withdrawal.

M. SCHMIDT

Now You Can Decode the Mysterious History of Numbers

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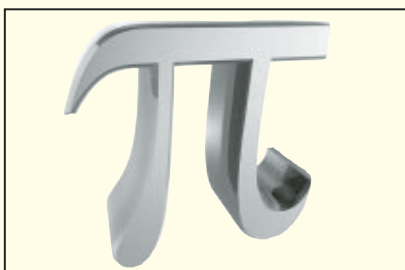
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About Your Professor

Edward B. Burger is Professor of Mathematics in the Department of Mathematics and Statistics at Williams College. He earned a B.A. with distinction in Mathematics from Connecticut College (*summa cum laude*) and his Ph.D. in Mathematics from The University of Texas at Austin. He is the recipient of numerous honors, including the prestigious Chauvenet Prize presented by

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Archimedes calculated pi, or the ratio of the circumference of a circle to its diameter, as 3.1418.

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A DIFFERENT SIDE OF ESTROGEN

Second receptor complicates efforts to understand hormone

BY SARAH C. WILLIAMS

The mice in Jan-Åke Gustafsson's lab are obese, their bones are brittle, and their spleens are unusually big. The female mice produce fewer and smaller litters than normal mice. They also are more likely to develop high blood pressure and a disease that resembles human leukemia. In fact, problems of one sort or another afflict almost every major organ system in their fragile, overweight bodies.

What these mice lack is the gene for an important molecule needed to fully respond to the hormone estrogen. Known as estrogen receptor beta (ER β), this molecule mediates most of the effects of estrogen not traditionally associated with the hormone. By genetically engineering both male and female mice without the receptor, researchers are digging up clues to its many important roles in people.

Discovered only a decade ago, the beta receptor has been found to protect against cancer, keep the immune system in check, help serious trauma patients survive their injuries, and keep people from being too anxious. A recent spate of studies on the receptor could lead to a new generation of hormone-based drugs for infertility, breast cancer, irritable bowel syndrome, depression, and a myriad of other conditions.

"Estrogen receptor beta, in particular, is involved in many, many tissues. It shows that estrogens are extremely important not only in reproduction, which everybody knows, but in other aspects of health as well," says Gustafsson, of the Karolinska Institute in Stockholm, Sweden.

Estrogen, a hormone that circulates in the blood, comes mainly from the ovaries, but is also made in small quantities by the placenta of pregnant women, the liver, adrenal glands, and breasts. In males, certain cells in the testes produce low levels of estrogen.

Estrogen affects various organs by entering cells and attaching to receptors inside them. Stimulated by estrogen, the receptors activate genes that change how the cells behave. But in every organ system, the changes may be different.

Understanding estrogen's effects has been complicated by scientists' long-held assumption that the hormone bound to only one type of receptor, now called estrogen receptor alpha (ER α). The uterus boasts a high concentration of the alpha receptor, and since researchers thought estrogen was only important for female reproduction, they had no reason to go looking for a different receptor in other organs.

But in 1996, while searching broadly for new hormone receptors, Gustafsson stumbled on estrogen receptor beta. That finding turned the field of estrogen research around, says Kenneth S. Korach of the National Institutes of Health.

At the time, Korach was studying mice missing the alpha receptor. It had been a surprise that these mice could even survive. "The

prevailing view was that you needed to have estrogen and you needed to have estrogen receptors," he says.

The discovery that there was a second receptor seemed to explain his results. If the mice missing the alpha receptor still had a functional beta version, their bodies still could respond to estrogen. At first, "everybody thought alpha was covering for beta and beta was covering for alpha," says Korach.

But when Korach bred mice lacking both receptors, the new mice survived too. "That clearly indicated that one does not need to have estrogen-receptor function to live," he says, "or for any type of developmental biology."

Though mice without the beta receptor can live, they are plagued by a list of health problems—a list that continues to grow as researchers observe the mice aging.

Bonnie Deroo, of the University of Western Ontario, in London (Canada), studies one impact of the missing beta receptor in female mice—fertility problems. Though these engineered mice can produce offspring, their litters are few and small. "Understanding how estrogen regulates ovulation may reveal causes of infertility in humans," she says.

"Estrogens are extremely important not only in reproduction, but in other aspects of health as well."

— JAN-ÅKE GUSTAFSSON,
KAROLINSKA INSTITUTE

Deroo's research focuses on estrogen in the ovaries, the female egg-producing organs nestled above the uterus. Ovaries, Deroo has found, have both alpha and beta estrogen receptors, but not in the same cells.

Deroo thinks the beta receptor may be involved in ovulation, the monthly release of an egg into a woman's uterus. Normally, estrogen produced by the ovaries causes the pituitary gland to release another hormone, called luteinizing hormone (LH) that directly triggers egg release. Deroo is trying to figure out what part of this cascade of hormones malfunctions in mice lacking beta receptors.

Korach studies this process to help women with infertility problems too, but he also points out another potential payoff from the research: estrogen receptor beta could be blocked in women as a form of birth control.

CANCER WATCHDOG Produced by plants, estrogen-like compounds called phytoestrogens are found in foods including soy and coffee. Some scientists have speculated that phytoestrogens played a key role in the lower incidence of prostate and breast cancers found for many years in Asian populations with soy-based diets.

This link doesn't surprise Gustafsson—the beta receptor responds to phytoestrogens much more potently than the alpha receptor does. Gustafsson thinks the beta version holds promise in combating cancer.

When estrogen binds to an alpha receptor, it usually signals the cell to start copying itself. This response is important in many situations, including making women's breasts and uteruses grow during pregnancy. But if something goes wrong while the estrogen receptor alpha is signaling the cell to multiply, cells may begin to grow uncontrollably and cancer could result.

"ER α seems to be, in that context, the bad boy or the bad girl," says Gustafsson. "But ER β is the watchdog."

Gustafsson's lab has shown that compounds that bind to only the beta receptor stop cells from multiplying. In mice, these drugs impede the growth of breast and prostate cancers.

Other labs studying the role of estrogen receptors in relation to cancer have found similar links in both males and females. Healthy breast and prostate tissues have more beta receptors than breast and prostate cancer samples, numerous studies have shown. Scientists have hypothesized that the lack of beta receptors in the cancer tissues allows the cancer to grow in the first place.

Compounds that bind to the beta receptor but not the alpha version, called ER β -specific agonists, also may be beneficial for a host of other health problems. These drugs, which turn on the beta receptor just as estrogen would, could even help patients survive severe physical injuries.

A paper published in the journal *Shock* in August 2000 found that females are more likely to survive traumatic injury, and less likely to go into sepsis—a severe bodily reaction to infection—than males. Scientists hypothesized that this finding could be because females have more circulating estrogen than males.

To follow up on this finding, another group of researchers gave estrogen or ER β -specific agonist to mice with lung injuries. In both groups of mice, the levels of inflammatory compounds in the blood instantly decreased.

The team, led by Heather Harris of Wyeth Research in Collegeville, Pa., also studied rats bred to develop inflammation in the joints, intestine, and skin. Scientists use these rats as models for human inflammatory diseases like rheumatoid arthritis and irritable bowel syndrome. Ten different ER β -specific agonists given to the afflicted rats decreased the inflammation and joint swelling.

Around the same time the link to chronic inflammation was found, researchers studying mice lacking the beta receptor noticed that the mice's immune systems weren't good at fighting off pathogens.

When the Wyeth scientists gave an ER β -specific agonist to mice infected with bacteria, more than 80 percent survived. No mice without the drug survived the infection.

LESSENING THE PAIN For people with chronic diseases, ER β -specific agonists could also decrease pain, says Gustafsson. While no such pain drugs have been developed yet, clinical observations of women depleted of estrogen show a possible link between the hormone and pain levels.

One such observation comes from women being treated for breast cancer with aromatase inhibitors, drugs that stop the body from making estrogen. This means that there's no, or very little, estrogen to tell the alpha receptor to make cells multiply. But it also means there's no estrogen to bind to the beta receptor.

Aromatase inhibitor side effects include osteoporosis, which is

thought to involve estrogen receptor alpha. But another side effect surprised doctors: Women taking aromatase inhibitors, such as Arimidex, reported feeling intense pain all over their bodies.

Now, based on experiments with mice, Gustafsson thinks the pain is linked to estrogen receptor beta.

"It seems that, generally speaking, ER β increases the pain threshold, that is, it decreases pain," says Gustafsson, "and ER α decreases the threshold, so everything hurts."

Put together, he says, the findings on the beta receptor's link to inflammation and pain mean that the next ibuprofen-like painkiller may be an ER β -specific agonist.

Based on his mice observations, Gustafsson thinks similar drugs could be designed as new anti-anxiety or anti-depression drugs.

When women reach menopause around age 50, and the amount of estrogen in their bodies sharply falls, many suffer severe depression. Gustafsson thinks this is no coincidence.

Estrogen receptor beta, after all, is plentiful in the brain. As embryos, mice develop beta receptors in their brains by the 12th day of growth. And adult mice lacking the receptor are violent and anxious, says Gustafsson.

"These mice attack each other," he describes. "They take the fur off each other."

In 2005, researchers led by Robert J. Handa of Colorado State University in Fort Collins performed a number of anxiety-related tests on rats treated with either ER β -specific agonists or ER α -specific agonists.

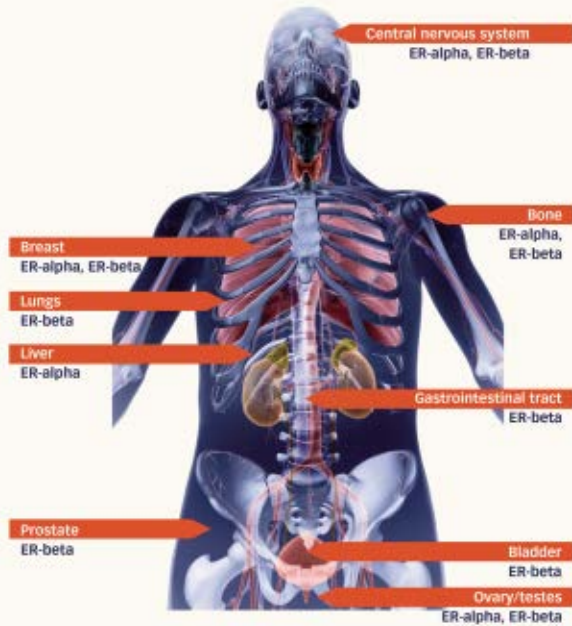
When alpha was stimulated, the researchers found, the mice became more anxious, avoiding open areas in a maze, for example. The rats given ER β -specific agonists, however, showed none of these anxious behaviors.

From the moment he discovered the second estrogen receptor, Gustafsson says, he knew its function wouldn't be the same as the original receptor. After all, he'd isolated it from a rat's prostate, and estrogen hadn't been thought to have a function in the prostate. A decade of findings on beta receptors has strengthened the view that the second receptor has little overlap with the alpha version. It's also become clear just how many body functions the beta receptor mediates. The next challenge will be to find ER β -specific compounds that can bind to the receptor in certain organs but not others.

HORMONAL ORIGINS The evolutionary history of estrogen receptors may explain their wide range of functions. In 2003, a scientist studying mollusks discovered that these shelled organisms have only one hormone receptor (*SN*: 9/20/2003, p. 94), and it binds estrogen. When the scientist, Joseph Thornton of the University of Oregon in Eugene, analyzed the receptor further, he found that it's like a hybrid of the two human estrogen receptors. The discovery suggests that estrogen receptors must have been around early in evolution, before invertebrates and vertebrates diverged.

Gustafsson hypothesizes that this primitive receptor gave rise to the two estrogen receptors and, eventually, perhaps to more modern steroid receptors, including the glucocorticoid, vitamin D, and progesterone receptors.

"One can easily envisage that the estrogen receptors, being the first steroid receptors, must have had significant functions in regulating lots of systems in these early primitive organisms," he says. ■



RECEPTOR RATIO — Estrogen's varied effects in the body can be explained by the balance of two kinds of estrogen receptors, alpha and beta, in different tissues.

NOT SO SPINELESS

Behaviors we expect from animals—but quirks and personalities? Studies of spiders and insects say maybe

BY SUSAN MILIUS

Chad Johnson wants to know what's up with all the black widow spiders. So do plenty of other people who've moved to Phoenix, or managed to be born there, in such numbers that it has become the fifth-most-populous city in the United States. Phoenix residents wonder why the population boom hasn't been limited to people. There, as in some other sunbelt cities, black widows have become the new cockroaches.

In the desert surrounding Phoenix, members of the same black widow species lead relatively solitary lives, in contrast to urban congestion among downtown spiders. So scientists like Johnson, at Arizona State University West in Glendale, ask why a supposedly cranky loner of a species has taken so enthusiastically to city life. Perhaps, he conjectures, the urbanization of the black widow has something to do with personality.

Yes, he's talking about the personalities of the spiders.

He and other researchers are looking beyond the general traits of a whole species to see what diverse patterns of behavior emerge within that species. It's too early to tell yet, but perhaps a portion of the former desert-dwelling black widows have quirks that let them thrive around bright lights and big cities.

So biologists are looking for personalities, or "behavioral syndromes," in a lot of strange creatures: spiders, dumpling squid, even crickets and water striders. From the beginning, the spineless set has starred in the new wave of exploring such personality possibilities.

The question isn't just whether the creatures have personalities. It's also about what difference the personalities make. In some species, suites of behaviors turn up in different situations. They can create interplay across situations, harmoniously or disastrously. A particularly macho spider might catch a lot of prey and grow fat and flossy, but then fail to prevail in courtship rituals that demand more finesse. Personalities might illuminate trade-offs in evolution of traits and might even explain some otherwise mighty peculiar animal behavior.

REAL CHARACTERS To build up gently to this idea of personality for spiders, think of variety. Think of aggression.

It's a part of life for funnel spiders (*Agelenopsis aperta*), says Ann Hedrick

of the University of California, Davis. They construct sheets of silk, a hand's breadth of white mist hovering over the ground or along a plant scaffold. In the center of the sheet, a slightly tapering silk funnel drops like a fat heating pipe to a safe haven under a rock or in a tuft of grass. Should one funnel spider walk on to another's web, the current owner dashes out of its tunnel to clarify who's home and who had better scuttle away.

"Why does any animal have a behavioral syndrome? Why do humans have a personality?"

— ANDREW SIH,
UNIVERSITY OF
CALIFORNIA, DAVIS

Some funnel spiders prove more aggressive than others, and similar differences hold true for populations, says Hedrick. She and Susan Riechert of the University of Tennessee in Knoxville compared aggression in spider groups from two states. The researchers paired opponents of equal size for duels, measured territory size, and clocked spiders rushing at prey.

Those spiders making do in arid grassland in New Mexico belonged to the same species as the funnel spiders

along a river in Arizona. Yet even when raised in the lab, the New Mexican strain overall could whip the Arizonians' opisthosoma. Hedrick and Riechert didn't use the word personality in the series of papers they wrote about these spiders during the 1980s and 1990s, but Hedrick talks about the New Mexican spiders as predictably more aggressive and the Arizona counterparts as less so.



LURKER — A funnel spider waits just inside its escape tunnel ready to pounce on lunch. Such spiders' readiness to return to this post after hiding offers a way to test for funnel personalities.

J. McDONALD/CORBIS

That evidence provides a first step for demonstrating personality—predictable variation between two groups of individuals of the same species. Hedrick and Riechert went on to test for something more interesting, links between aggression and other tendencies.

Spiders differed in how cautious they were around predators. The web sheet doesn't have goo to snare an insect that lands on it, so hungry spiders lurk in the mouths of their funnel, ready to shoot out when prey arrives. The tunnel mouth makes a great position for hunting but leaves the spiders partly exposed to birds, mice, and other animals that, in turn, are hunting them.

Hedrick and Riechert mimicked the rush of air and web vibrations of an incoming bird by puffing at the spiders with a squeezable bulb designed to blow dust off camera parts. The New Mexican spiders proved less fearful. When puffed at, these spiders did dive into their tunnels for shelter. Yet the New Mexicans didn't take as long as the Arizonians to tiptoe back out to their hunting spots.

So the New Mexican's kick-carapace fighting approach might share a link to another trait, a tendency to get over a scare quickly. To explore that possibility, the researchers narrowed their study to the level of individual spiders. In another tournament of spider fights, the individuals that proved feistier were the same ones that had recovered faster from the scary camera puffer. The two behaviors, exhibited in different circumstances, did seem to share a link.

When spiders from the two populations had offspring in the lab, the youngsters still differed despite growing up in the same environment. The researchers concluded that each of the behavioral traits had a genetic basis. Hedrick speculates there's a strong possibility that testing individuals within populations would reveal a genetic link between behaviors.

YOU SAY SYNDROME Debating just what to call such linked behavioral tendencies—personality? behavioral profile?—can start a bar fight in some quarters.

Andrew Sih of the University of California, Davis, has been arguing (nonviolently) for behavioral syndrome. In 2004, he, Johnson, and Alison Bell, now at the University of Illinois, Urbana-Champaign, published an overview defining "behavioral syndrome" as "suites of correlated behaviors across situations." In 2006, Sih led a symposium on behavioral syndromes at the Animal Behavior Society's annual meeting.

That definition leaves plenty of interpretive wiggle room. But Hedrick sees the funnel spiders as a clear example of correlation: The spiders genetically predisposed to thrash rivals in a fight tended to return to business fast after an upset.

So she's able to address the question of how that link might affect evolution. A trait favorable in one situation may be a hindrance in another. The two lineages of spiders came from habitats with very different pressures, and in their case, the link between the behaviors was to their benefit.

The Arizonian's riverbanks buffer the extremes of temperature and provide plenty of insect prey. Birds, however, also feast on the riparian abundance. When feeding chicks in nesting sea-

son, birds along the river killed a weekly average of 40 percent of the funnel spiders in test plots, Hedrick says.

In contrast, the New Mexicans have a tough time finding food in their sparse grassland. Dependent on their environment for regulating body temperature, they work their webs only during the few hours when the nightly chill has eased and before the day has turned scorching hot. At least the slim pickings out there mean predatory birds are relatively rare too.

Facing such scarcity, it's no wonder the New Mexicans have turned scrapper. They compete more fiercely among themselves for food than the Arizonians do, says Hedrick. Because some common underpinning unites the two traits, that heightened aggression also favored the tendency to return to normal quickly after a close call from a bird attack.

On the relatively plush riverbanks of Arizona, though, relentless predation could be pushing the spiders toward caution and longer hiding times in their funnels. In turn, this fearfulness carries with it the milder manners.

Since the spider work, Hedrick has found another set of linked behavioral

traits, this time in field crickets (*Gryllus integer*). One of the traits is male sex appeal. The males trill to display their charms, and some trill longer than others. For winning the attentions of a female cricket, longer is better. Hedrick has found that the length of the male trill is heritable. When she tests crickets for their reactions to predators, "males with more extravagant displays are more cautious," she says.

Hedrick is now working on a possible new twist. She has staged rounds of cricket battles and discovered that caution around predators tends to go with losing fights. So she is testing her chain of connections to see if males with hot trills get whupped. If so, the usual pattern of animal mate choice upends itself, as females pick up males from the floor of the fight club.

ODD COUPLE Such counterintuitive combos of traits illustrate one of the beauties of the idea of behavioral syndromes, says Johnson. An animal's behavioral syndrome can foster beneficial action in one situation but screwy, even maladaptive, acts in another. So finding a syndrome could explain some otherwise baffling traits.

The fishing spider (*Dolomedes triton*), which Johnson and Sih study, raises a question, all right. The most ferocious females in a population sometimes eat their suitors. Sexual cannibalism isn't all that rare among spiders, but the most extreme among the fishing spiders kill before they can mate.

Those females do lay eggs, but unfertilized, so the eggs don't develop. Considered as an isolated phenomenon, there is no way that premature mate murder makes sense.

In the 1990s, evolutionary biologist Göran Arnqvist of the University of Uppsala in Sweden suggested looking at more than one behavioral trait at a time to see whether mate killing represents a spillover of some other trait. Outsized aggression, for example, could bring rewards as the juvenile females scramble for food. A dead suitor later in life would amount to a side effect of the teenage appetite.



TEEN HUNGER — Fishing spiders, such as this one munching on prey, hunt well around water, sometimes too well. Champion-hunter females may prosper as youngsters but end up killing their suitors prematurely.

Johnson and Sih have been studying that as a scenario for a behavioral syndrome. Overall, their results support the spillover/syndrome concept, he says. For example, juvenile females grew larger when they fed on abundant food, and that size bonus led to a spiderling bonus. The most recent paper, in the November 2007 *Animal Behaviour*, explores whether the proposed syndrome of boldness extends to a spider's parental care (no), speed of recovery from alarm (yes, for adult spiders), and zest for hunting (also yes for adults).

In another case of a behavioral syndrome with mixed blessings, extra zest for a fight turns ugly when water striders go courting.

The long-legged species *Aquarius remigis* skates over pond and stream surfaces right into odes to the tranquillity of nature. In the real world, though, water striders lead contentious lives. Males fight each other readily and don't wait for invitations to zoom over the water pursuing females.

For an unusual look at the consequences of all this machismo, Sih and U.C. Davis colleague Jason Watters sorted male water striders into a number of groups. One group included only the most aggressive and active males; the other groups had fewer and fewer of the rambunctious types. The last strider club included only males with relatively mild ways.

When the groups mingled with females, the go-getters didn't fare so well. They dashed around with unusual energy, but females shied away from them and even fled the group. In tallying the matings in each group, the researchers could track the effect of extra-aggressive males. Their abrasive manners dragged down the mating success of milder males in the same group.

The whole idea of these mismatched consequences for traits unsettles Bryan Neff of the University of Western Ontario in London (Canada). "I don't challenge that behavioral syndromes can exist in nature," he says. It's their prevalence and utility he's waiting to see. Evolutionary forces should routinely render the syndrome irrelevant by lightening its dark side, he argues. If a gene makes an animal a bold hunter but a lousy lover, then Neff predicts a modifier gene will eventually arise and mute the bold-



ROUGH ON WATER — Among water striders, the more aggressive males have trouble in courtship as their rough ways scare off females.

ness when it gets in the way.

Sih likewise muses about how much remains unknown. He says he's looking for a framework that could predict why behaviors sometimes end up correlated and sometimes not. If he can figure out that, he could tackle some other big questions. "Why does any animal have a behavioral syndrome?" he says. "Why do humans have a personality?" ■

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ENVIRONMENT

Smog's heavy impacts

Breathing smoggy air diminishes the ability to breathe deeply in overweight people more than it does in lean folks. The new finding mirrors an effect recently seen in rodents.

About a decade ago, Milan J. Hazucha of the University of North Carolina (UNC) in Chapel Hill and his colleagues exposed people for 90 minutes to ozone, the primary respiratory irritant in smog. The goal had been to evaluate the effect of age on how sensitive adult lungs were to ozone levels representative of a very smoggy day.

But publication of the new animal findings prompted Hazucha's group to reevaluate data from that earlier trial. The researchers looked at healthy men and women for signs that ozone's ability to alter breathing capac-

ity might have varied with body mass index (BMI), one measure of fatness.

"We didn't expect to see an effect," admits William D. Bennett of UNC, who headed the analysis. But a trend indeed emerged showing that, in general, the heavier a recruit had been, the more trouble he or she had breathing deeply after exposure to substantial ozone. The correlation proved significant only in women who, as a group, also exhibited a broader range of BMIs. Bennett's team reports its findings in the November 2007 *Inhalation Toxicology*.

The team is now recruiting lean and obese women for a follow-up trial to evaluate lung impacts during exposure to ozone, not just afterward. Unlike the earlier trial, this one will also probe for signs that ozone exaggerates a marker of asthma risk. —JANET RALOFF

PHYSICS

Tiptoe acrobats get it just right

If walking on water takes grace, jumping on it requires exquisite care.

Water striders spend most of their lives on a water surface, typically that of a pond.

Microscopic hairs, coated with a waxy substance, make the striders' long legs extremely water-repellent, enabling the bugs to rest on water as if the surface were a rubber membrane.

As the name implies, water striders are also accomplished at water walking—more like skating. Scientists know that water striders propel themselves by creating vortices under the water's surface, similar to how birds fly by creating vortices in air. But what has been puzzling is that water striders also manage to jump, says Ho-Young Kim, an applied physicist at Seoul National University in South Korea.

To understand how the striders do it, Kim and his colleague Duck-Gyu Lee dropped highly water-repellent spheres the size of large sand grains onto a water surface. For low-impact speeds, the spheres stuck to the surface like leaves falling on a pond. When moving fast enough, the spheres broke the surface and sank. But for speeds within a narrow window of about 1.3 meters per second, the spheres bounced off.

The findings mean that to leap off the surface, a water strider "pushes the water surface just the right amount," Kim says. The report appears in the Jan. 1 issue of *Langmuir*. —DAVIDE CASTELVECCHI

MEETINGS

American Academy of Anti-Aging Medicine
Las Vegas, Nev.
Dec. 12–15, 2007

NEUROSCIENCE

Milking performance from damaged brains

Given intravenously, a molecule found in breast milk can improve mental function in people with dementia and in victims of stroke and traumatic brain injury.

Researchers at the University of Palermo in Italy tested the molecule, called glycerophosphocholine (GPC), for its effect on neurological functioning in 2,044 stroke victims. GPC improved the patients' performance by 27 percent compared with patients not given the treatment, the scientists reported in the *Annals of the New York Academy of Sciences*.

In 12 separate trials by different research groups, GPC also significantly improved memory, attention, and orientation in people with various forms of dementia, including Alzheimer's disease. And mice given GPC recovered from induced brain injuries more quickly than untreated mice, says Parris M. Kidd, a biologist at Crayhon Research, a Reno, Nev., company that sells brain nutritional supplements.

GPC works by increasing the number of receptors on brain cells for nerve growth factor, a signaling protein that spurs production and survival of nerves. GPC can readily cross the blood-brain barrier, a layer of cells that surrounds blood vessels in the brain and controls which proteins and other large molecules can pass from the blood to nerve cells. These cells can also convert GPC into choline, which they then use to make acetylcholine, a chemical messenger that carries signals between nerves. —PATRICK BARRY

NUTRITION

Keeping metabolic syndrome at bay

Chromium supplements might stave off the life-shortening effects of metabolic syndrome, a condition that can lead to diabetes and heart disease.

People with metabolic syndrome have high blood sugar levels and high blood

pressure, among other health problems. The syndrome mostly occurs in sedentary older adults who eat high-calorie diets.

Harry G. Preuss, a nutrition specialist at Georgetown University in Washington, D.C., and his colleagues gave chromium supplements to 12 rats belonging to a strain with a strong tendency to develop metabolic syndrome. The researchers used a form of chromium called niacin-bound chromium (NBC), which absorbs more readily into the blood than some other commercially available chromium supplements.

After 10 weeks, the rats had consistently lower blood pressure and blood sugar than a group of rats that received no supplements. The chromium-fed rats also lived 19 percent longer on average than the control group.

Chromium also reduced blood concentrations of the hormone angiotensin II, which causes blood vessels to constrict. High levels of angiotensin II in the blood have been linked with poor cardiovascular health. The angiotensin II reduction, Preuss says, "may be another factor in the increased longevity emanating from NBC intake."

Standard blood tests didn't reveal any negative health effects from the treatment, Preuss says. —P.B.

American Geophysical Union
San Francisco, Calif.
Dec. 10–14, 2007

PALEONTOLOGY

Struck from above

Evidence of an extraterrestrial object striking Earth at the height of the last ice age comes not from a crater in the ground, but from the micrometeorites embedded in the tusks of creatures grazing the Alaskan tundra when the event occurred.

Richard B. Firestone, a nuclear physicist at the Lawrence Berkeley (Calif.) National Laboratory, and his colleagues have examined thousands of fossils collected in Arctic regions. Among those relics, the researchers found eight mammoth tusks—representing about 0.1 percent of the fossils—that have small metallic particles embedded in them. X-ray images reveal zones of shattered material around each particle. When multiple particles are found on a single fossil, all of them appear on the same side of the tusk—as if they came from the same direction, says Firestone.

The particles, which are strongly attracted to a magnet, are mostly made of iron, a common component of many meteorites. Chemical analyses of the particles revealed an abnormally high proportion of nickel and a lower-than-average concentration of titanium—both of which hint at an extraterrestrial origin, Firestone notes. Carbon-dating techniques suggest that most of the iron-peppered tusks are between 30,000 and 34,000 years old.

Previous studies had suggested that several animal populations living on the land bridge connecting Alaska to eastern Siberia at that time—including bison, bears, horses, and mammoths—declined significantly at some point less than 36,000 years ago. The impact of an extraterrestrial object, such as the one purported to have plagued these Alaskan mammoths, could have rendered much of northern Alaska inhospitable for decades, if not longer, says Firestone. —SID PERKINS

SCIENCE & SOCIETY

An earlier thaw can trim winter logging

Global warming, rather than increasing opportunities for development in cold northern regions, can detrimentally affect a region's economy. In New Hampshire, for example, the trend toward earlier spring thaws has significantly lowered logging revenues, a new study suggests.

During the past 4 decades, winter temperatures in New England have risen about 2°C, says Jennifer B. Wurtzel, a

climatologist at the University of Michigan in Ann Arbor. That warmer winter weather, in turn, has reduced the number of days on which unimproved roads are frozen and therefore able to support the weight of a truck loaded with fresh-cut timber.

New Hampshire is the second-most forested state in the nation, after Maine. To assess the effect of a warming climate on the state's logging industry, Wurtzel and colleague Cameron P. Wake, a climatologist at the University of New Hampshire in Durham, used weather data to estimate the change in the number of frozen-road days each year between 1970 and 2007. Towns in northern New Hampshire, where logging in the state is most prevalent, now have on average 9 fewer frozen-road days each winter than they did in 1970. Over the same period, towns in central New Hampshire have lost about 10 frozen-road days, the researchers found.

Data from previous studies suggest that a loss of 9 frozen-road days each year, about 10 percent of the logging season, translates into a loss of \$1 million in logging fees paid to landowners. —S.P.

ATMOSPHERIC SCIENCE

No-drive experiment curbs air pollution in Beijing

Traffic-control measures can significantly reduce urban air pollution, a field study done in Beijing this summer indicates.

Beijing, a city of 15 million people and 3 million cars, has notoriously bad air, and it's getting worse, says Tong Zhu, an atmospheric chemist at Peking University in Beijing. To assess how traffic-control measures might help curb pollution during this summer's Olympics, researchers reduced the number of vehicles on the city's roads from Aug. 17 through Aug. 20, a 4-day period that included two work days and one weekend. Pollution was measured by sensors on satellites, low-flying aircraft, and balloons, and at ground stations around the city.

During the test, half of the region's non-commercial, nongovernment vehicles—around 1.3 million—were kept off the roads from 6 a.m. to midnight each day. In general, reductions in pollution were larger on weekdays than on the weekend. Overall, daily reductions in nitrogen oxides in city air during the experiment ranged from

17 to 50 percent, and decreases in the concentrations of volatile organic chemicals, major contributors to the formation of ground-level ozone, ranged from 20 to 33 percent. Atmospheric concentrations of carbon dioxide consistently measured about 22 percent lower than they do on normal traffic days, Zhu adds.

Such reductions won't meet the goals for air quality set by the government for the upcoming Olympics, Zhu and his colleagues note. Additional traffic control, as well as restrictions on construction, industries, and power plants in the region, will be necessary to reduce pollution the requisite amount. —S.P.

CLIMATE CHANGE

In 2007, Greenland set a melting record

The duration and extent of ice melt across high-altitude portions of the Greenland ice sheet last year were the highest they've been in recent decades, satellite observations indicate.

By measuring microwave radiation reflected from a snow-covered patch of ice, scientists can discern if any of the snow has melted, says Marco Tedesco, an electrical engineer at NASA's Goddard Space Flight Center in Greenbelt, Md. To gauge the severity of snowmelt across an area during a particular season, Arctic researchers developed a melting index, which is calculated by multiplying the area where snow melted by the length of time that melting occurred there.

Greenland is an island about three times the size of Texas. This year, surface temperatures across portions of the island's ice sheet were between 4°C and 6°C above average, says Tedesco. As a consequence, snow melted in some areas for as much as 30 days longer than the average melt duration recorded from 1988 through 2006. Since 1988, the average extent of the island's snowmelt has increased each year by 19,000 square kilometers, an area slightly smaller than the state of New Jersey.

Altogether, this year's melting index for high-altitude portions of Greenland's ice sheet—those above a 2,000-meter altitude—was 2.5 times the annual average from 1988 to 2006. That's a new record, says Tedesco. For all of Greenland, 2007's melting index was 30 percent above average, the fifth-highest melting index yet recorded. Scientists estimate that the amount of ice lost from Greenland this year alone is about twice that now present in Europe's Alpine glaciers. —S.P.

Books

A selection of new and notable books of scientific interest

SNAKE OIL SCIENCE: The Truth About Complementary and Alternative Medicine

R. BARKER BAUSELL

A former government myth buster—he has tested claims of complementary and alternative medicine for the National Institutes of Health—Bausell writes that most nonmainstream remedies actually work. But the reasons why they work are rarely what their proponents claim, and indeed may have more to do with mental conditioning, also known as the placebo effect. The placebo effect is real. At least for pain management, the mind can trigger the body's own opioid system to produce pain-relieving chemicals, Bausell writes. But placebos can and should be cheap, while many alternative prescriptions are not; Bausell's goal is to help consumers spend their money wisely. He offers an overview of alternative and complementary treatments. He explains why most such treatments can't possibly do what their proponents claim, but he rarely takes on the scoffing tone that many skeptics use when discussing these issues. *Oxford Univ. Press, 2007, 324 p., b&w illus., hardcover, \$24.95.*

MAGICAL MOMENTS OF CHANGE: How Psychotherapy Turns Kids Around

LENORE TERR

Child psychiatrist Terr, a foremost expert in childhood trauma, draws on her own experience and that of 33 of America's top child and adolescent psychiatrists to explain, step by step, how children change during treatment. Within a four-part framework, Terr writes of using the professional persona, creating the right atmosphere, getting to the child, and reacting in a timely fashion. The focal point of the book is Terr's 15-year journey with a patient who came to her as a toddler after having been sexually abused and witnessing her sister's murder. Interwoven are shorter accounts of other troubled young people. All told, Terr presents 48 cases, each of which illustrates the varied ways psychotherapists help turn kids' lives around. She seeks to answer two overriding questions: How and when does psychotherapy work? What happens to make it work? The answers are as varied as the children and patients themselves. *W.W. Norton, 2007, hardcover, 304 p., \$27.95.*

A LIFE DECODED: My Genome: My Life

J. CRAIG VENTER

In this "bad boy gone good" autobiography, J. Craig Venter tells of how he went from being a self-proclaimed adrenaline junkie who skipped school to catch waves to the man who raced against the National Institutes of Health to sequence the human genome. That genome was Venter's own, and it's

woven throughout this story in sidebars, driving home the idea that nature has a lot to do with the supposed choices we make. For example, Venter attributes the fact that he never became addicted to pot or alcohol while serving as a Navy medic in the Vietnam War to his particular variation of the dopamine receptor gene, (D2) *DRD2*, which has been linked to substance abuse. Like the human genome, multiples pack this book—multiple wives, multiple biotech companies, multiple yacht races, multiple microbial sequences within a water droplet, and multiple political disputes that Venter waged against the head of the Human Genome Project and Nobel laureate James Watson, to name but a few. *Viking, 2007, 390 p., color photos, hardcover, \$25.95.*

WHAT IS EMOTION? History, Measures, and Meanings

JEROME KAGAN

As neurobiologists set out to identify regions of the brain corresponding to fear, anxiety, happiness, and indecision, psychologists may wonder whether those clear categories misrepresent true emotion. Jerome Kagan, a pioneer of developmental psychology at Harvard University, is one such critic. Emotions, he writes, vary depending on context. Anxiety from a panic attack is different than that faced by a social phobic in a crowded shopping mall. He questions the assumption that brain scans of emotional states captured in a lab would look the same in everyday life. Kagan instead surveys a broad range of qualitative ideas from anthropology, psychology, and neurobiology to discuss the complexity of emotion as we know it. The book provides a guideline to the challenges to be met before the range and overlap of our joy, rage, and sadness can be understood. *Yale Univ. Press, 2007, 271 p., hardcover, \$27.50.*

COSMOLOGICAL ENIGMAS: Pulsars, Quasars, and Other Deep-Space Questions

MARK KIDGER

Sometimes the most basic questions expose big gaps in scientific knowledge. Questions as basic as how did the universe start? How will it end? Humans have pondered the night sky since the beginning of civilization, yet many of their questions about it remain. Mark Kidger, an astronomer at the European Space Astronomy Centre in Madrid and author of *Astronomical Enigmas: Life on Mars, The Star of Bethlehem, and Other Milky Way Mysteries*, embraces the great unknown, presenting the cosmos as a living, writhing backdrop against which stars might explode in supernovas or collapse into black holes. So enormous is that universe, writes Kidger, that it can be cruel to scientists who meticulously formulate theories, only to learn that their ideas must be refined or overturned entirely. But this, too, is part of the thrill. After all, a challenge to the Big Bang would mean that something of stunning proportions had been discovered. *Johns Hopkins Univ. Press, 2007, 224 p., color photos, hardcover, \$30.00.*

LETTERS

Missing link

"Antibiotics in infancy tied to asthma" (*SN: 7/7/07, p. 14*) reported a correlation but no confident explanation for the relationship between receiving antibiotics and later developing asthma. "Ulcer bug may prevent asthma" (*SN: 10/27/07, p. 270*), which reports that children with *Helicobacter pylori* in their stomachs are less likely to get asthma, seems to offer a convincing answer. **VIRGINIA BROCK, ROCK ISLAND, ILL.**

Do the math

"Strategies to improve teaching" (*SN: 12/8/07, p. 366*) says that American students' science and math skills have been falling relative to those of their peers in other countries. How true. Recent tests put the United States in 14th place in an international comparison. But at least we are still in the top 10! **TOM REESOR, CONWAY, S.C.**

The scenic route

We in Maine were surprised to learn that the beautiful Penobscot Narrows Bridge runs between Bangor and Brewer ("Bad Vibrations," *SN: 11/24/07, p. 331*). In fact, it connects Prospect, in Waldo County, with Verona, in Hancock County. The three bridges that connect Bangor and Brewer are frankly boring in comparison. And if you're in the area, please head 30 miles up the coast to Sedgwick to see the Deer Isle Bridge. This lovely and much-repaired suspension bridge over Eggemoggin Reach is the sister to the infamous Tacoma Narrows Bridge, and while mostly stable, can make for an entertaining trip on a very windy day. **JOANNA LINDEN, WATERTOWN, MAINE**

Dental record

The DNA analysis indicating that some south Siberian bones from the Pleistocene age are from Neandertals ("Ancient DNA moves Neandertals eastward," *SN: 10/13/07, p. 238*) matches very well with my interpretation of teeth from those same caves. I proposed in 1990 that the teeth were more like those of Neandertals than any other fossil or modern teeth. Furthermore, it is doubtful that these south Siberian Neandertals evolved into anatomically modern humans, as some Russian workers believe. **CHRISTY TURNER, TEMPE, ARIZ.**

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