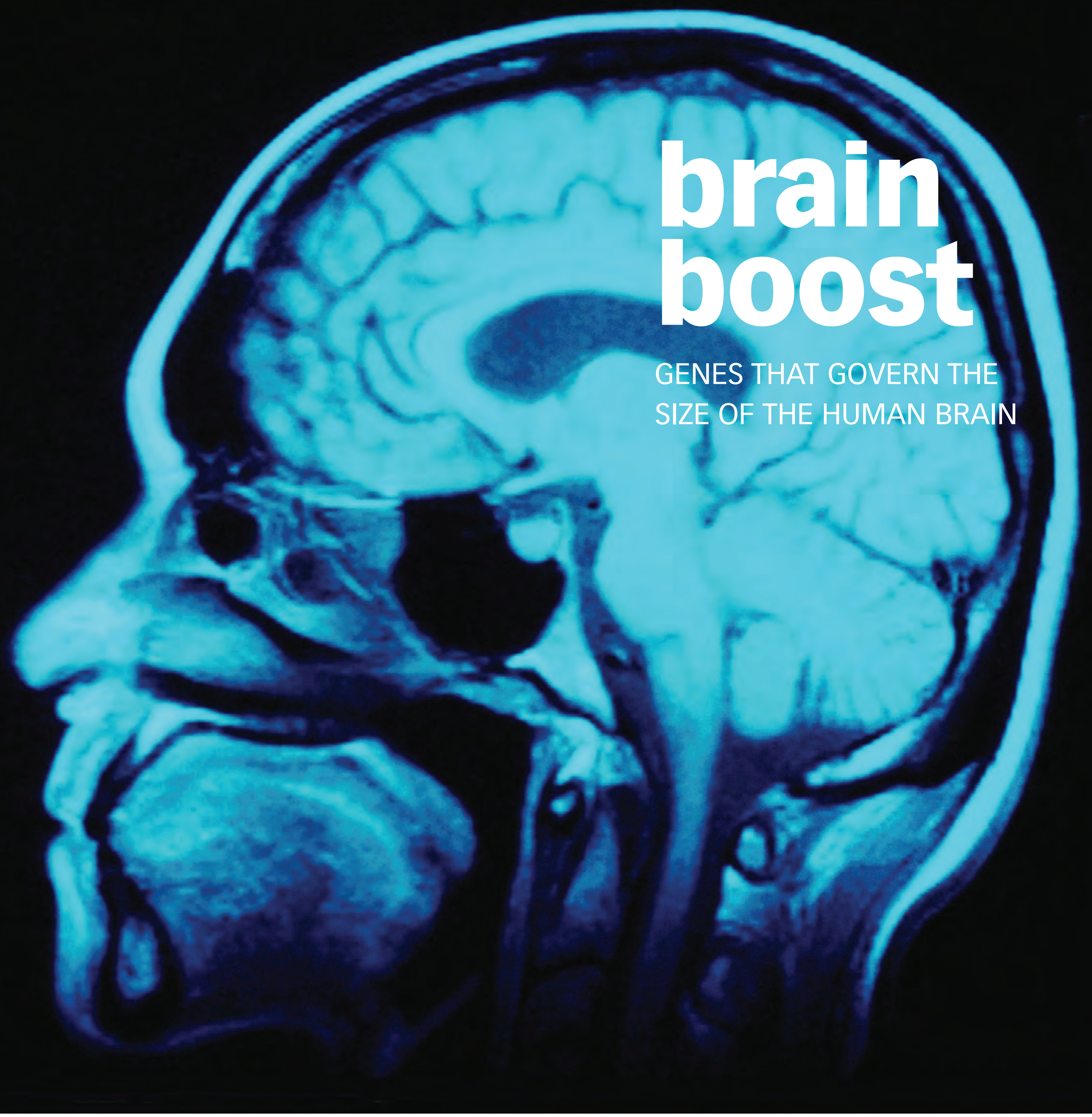
SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

NOVEMBER 16, 2002 PAGES 305-320 VOL. 162, NO. 20

www.sciencenews.org



brain boost

GENES THAT GOVERN THE SIZE OF THE HUMAN BRAIN

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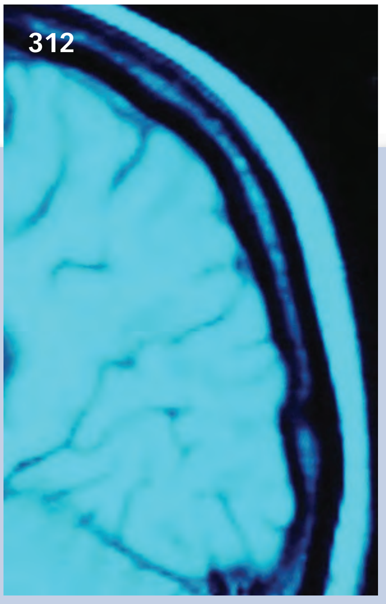

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Of Note

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Cover The cerebral cortex, the convoluted brain surface seen in this magnetic-resonance image of a human head, is much bigger in people than in nonhuman primates or other animals. Scientists are now identifying genes that control the growth of the cortex and that may have played a role in the evolution of human intelligence. Page 312

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Science News (ISSN 0036-8423) is published weekly on Saturday, except the last week in December, for $54.50 for 1 year or $98.00 for 2 years (foreign postage is $18.00 additional per year) by Science Service, 1719 N Street, N.W., Washington, DC 20036. Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

POSTMASTER
Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Change of address: Two to four weeks' notice is required—old and new addresses, including zip codes, must be provided.

EDITORIAL, BUSINESS, AND ADVERTISING OFFICES 1719 N St. N.W., Washington, D.C. 20036
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LETTERS editors@sciencenews.org

SUBSCRIPTION DEPARTMENT P.O. Box 1925, Marion, OH 43306. For new subscriptions and customer service, call 1-800-552-4412.

Science News is published by Science Service, a nonprofit corporation founded in 1921. The mission of Science Service is to advance the understanding and appreciation of science through publications and educational programs. Visit Science Service on the Web at www.sciserv.org.

SCIENCE NEWS
This Week

Shaked Alaska

A sleepy fault wakes and reveals new links

Many Alaskans will never forget where they were at 1:12 p.m. on Nov. 3, 2002. That's when a magnitude 7.9 earthquake, one of the most powerful recorded on U.S. land, shook south-central Alaska. Shelves fell, cars bounced, people tumbled off their feet, trees split open.

The earthquake might elucidate the murky relation between the 400-mile-long Denali fault and other Alaskan faults, according to scientists who've begun analyzing the event and its aftershocks. Visible from space, the Denali fault rivals California's San Andreas fault in size but, during at least the past century, has been far less active.

Most Alaska earthquakes occur offshore or tens of miles beneath Earth's surface, but the epicenter of this whopper lay inland—90 miles south of Fairbanks—at a depth of 3 miles. A magnitude 6.7 temblor on Oct. 23 is now considered a foreshock.

"These earthquakes are the first significant events on the Denali fault since 1912," says Jeffrey T. Freymueller, a geophysicist at the University of Alaska in Fairbanks.

The Nov. 3 Denali earthquake shook so long and hard that it reportedly moved a viaduct by a half-inch in Seattle. It triggered tremors in Wyoming's Yellowstone National Park and sloshed water in ponds in Texas and Louisiana. The earthquake was blamed for muddied tap water the next day in several states including Pennsylvania, where water tables dropped as much as 6 inches.

Remarkably, few injuries and no deaths were reported in the vicinity of the 186 miles of ruptured fault line. And the Trans-Alaska Pipeline, designed to withstand a magnitude 8.0 earthquake, held its own despite some damage to its structural supports. However, the Tok Cutoff Highway, which crosses the fault, shifted 22 feet.

Scientists reported massive avalanches, including one that crossed a 1.5-mile-wide glacial valley and then flowed up the slope of the next mountain. Patricia A. Craw of Alaska's Department of Natural Resources in Fairbanks describes places as looking "like the snow pack had exploded off the mountainsides."

The quake also cracked glaciers in two along the fault, a phenomenon not observed since the Lituya Bay earthquake in 1958. "It's very surprising how clearly you can see the fault trace as it cuts up glaciers," says Peter J. Haeussler of the U.S. Geological Survey in Anchorage.

The quake provided information hinting that two remote, poorly studied Alaskan fault systems may align with the San Andreas fault. The Nov. 3 event moved not only the Denali fault but also an ice-hidden portion of the nearby Totschunda fault. Geologists say that the recent temblor might have originated as a thrusting movement along the western Denali, then moved eastward as a slipping motion before turning southeasterly into the Totschunda.

The newly confirmed Denali-Totschunda connection has excited geologists because the visible parts of the Totschunda are in line with the larger Fairweather-Queen Charlotte fault system. This system is the northern continuation of the San Andreas fault.

The Denali fault's movement also might confirm a motion previously detected with global positioning systems (GPSs). A huge wedged block of Earth's crust in southern Alaska is rotating counterclockwise, grinding and colliding with other landmasses, Freymueller says.

Geologists are scrambling to install seismometers and portable GPS instruments in the still-trembling Denali area before winter kicks in. "We're going to have an extremely rich data set," promises Freymueller. "There's a lot more to come." —C. MARZUOLA

HAEUSSLER, U.S. GEOLOGICAL SURVEY

ICE QUAKE A trace of the Denali fault runs up the Canwell Glacier in the Alaska Range.

Thoughtful Lessons

Training may enhance intellect in elderly

Among physically healthy seniors, advancing age often takes a toll on memory and other mental abilities. There's encouraging news, though, for those who want to boost their brainpower.

A brief training course in any of three domains of thought—memory, reasoning, or visual concentration—yields marked improvement on tests of these cognitive skills, according to the largest geriatric study to date of these instructional techniques. The enhancement lasts for at least 2 years.

"Improvements in memory, problem-solving, and concentration following training roughly counteracted the degree of cognitive decline that we would expect to see over a 7-to-14-year period among older people without dementia," says psychologist Karlene Ball of the University of Alabama at Birmingham. Ball and her colleagues report their findings in the Nov. 13 *Journal of the American Medical Association.*

It's not yet clear whether training-induced effects translate into improved thinking in everyday situations, cautions Ball.

In their study, the scientists recruited 2,832 men and women, ages 65 to 94. They came primarily from senior-housing sites, community centers, and medical facilities in six urban regions of the United States. Participants were in good health and living independently.

These volunteers were randomly assigned to one of three training groups or a control group that didn't receive any training. One course of instruction focused on ways to improve memory for word lists and stories. Another bolstered reasoning in problems analogous to daily tasks such as reading a bus schedule. A third coached participants to identify visual information quickly in computer displays that corresponded to challenges such as reading traffic signs while driving.

Each training course consisted of 10 roughly hour-long sessions over 5 to 6 weeks. Most who completed training received a refresher set of four training sessions 11 months later.

Immediately after the first round of sessions, 26 percent of memory-trained participants, 74 percent of reasoning-coached volunteers, and 87 percent of those instructed in visual concentration showed substantial improvement on the targeted skill. While most members of the no-training group showed no change or declined, a small number improved as much as those who had received training.

The proportion of trained participants scoring markedly above their starting value dipped slightly over the next 2 years but remained greater than the proportion of untrained volunteers who upped their performance similarly. Refresher sessions enhanced training-induced gains in reasoning and visual concentration but not in memory.

"I think we can build on these results to see how training ultimately might be applied to tasks that older people do everyday, such as using medication or handling finances," comments psychologist Richard M. Suzman of the National Institute on Aging in Bethesda, Md. —B. BOWER

GOOD LISTENER A harbor seal can learn enough about the dialects of the killer whale to distinguish the sounds of harmless neighbors from those of seal killers.

NOAA

Ear for Killers

Seals discern foes' from neighbor-whales' calls

Killer whales that eat fish chatter in dialects with up to 17 kinds of calls. Researchers now say that harbor seals eavesdrop on the whales and can tell the harmless neighborhood fish eaters from roving gangs with a taste for fresh seal.

The recent experiments also suggest how the seals' predator alarm develops, says Volker B. Deecke of the Vancouver Aquarium Marine Science Centre in British Columbia. The seals start with an aversion to all killer whales but learn to ignore the local fish eaters, Deecke and his colleagues contend in the Nov. 14 *Nature*.

Killer whales can live a variety of lifestyles. Those that cruise the western coast of North America typically either stay home eating fish or roam the coast preying on seals and other mammals. Most fish can't hear the high whale-call frequencies, and fish eaters make a lot of noise. Seals and other mammals can tune in, and mammal-killing whales typically hunt silently and call after they've made a kill.

To investigate the eavesdropping seals, Deecke and his colleagues made recordings of calls from whales off the coasts of British Columbia and Alaska. The mammal eaters' wails feature "long downward slides" that strike Deecke as "melancholy" and "very haunting." He says the fish eaters sound "more upbeat."

During the experiment, Deecke spent days playing the recordings underwater to seal congregations in British Columbia. Local fish-eater chatter made fewer than 5 percent of seals swimming at the surface dive for safety. In contrast, the haunting sounds of the visiting mammal eaters drove away some 40 percent of the seals.

Deecke asked whether the seals had learned to fear the roving killers or were innately afraid of killer whales but had learned to ignore the harmless locals. So, he played recordings of fish eaters from Alaska, which chatted in dialects that Deecke's seals had never heard before. Those sounds caused as much alarm as the wails of the roving seal killers.

Deecke says that he doesn't know of another animal that distinguishes between dialects of a different species. However, for defense, it's probably advantageous to start with a generalized fear and then recognize the dialect of a benign neighbor. Learning too slowly who's an enemy can be fatal, whereas learning too slowly who's harmless just wastes effort, Deecke points out.

Ecologist James Estes of the U.S. Geological Survey in Santa Cruz, Calif., welcomes the work as part of a growing body of research on how intricate predator-prey relationships can be (*SN: 10/17/98, p. 245*). He says that, like Deecke, he's seen seals ignore some killer whales. Estes calls the new paper's explanation for the phenomenon "elegant in its simplicity." —S. MILIUS

The Brain's Funny Bone

Seinfeld, *The Simpsons* spark same nerve circuits

Neuroscientists—normally a reserved group—were laughing at William M. Kelley's presentation. He wasn't upset, however. The researcher had just shown the scientists a clip from the sitcom *Seinfeld* to illustrate how his group investigates the brain's response to humor.

With the aid of Jerry Seinfeld and his friends, as well as the animated characters of the cartoon *The Simpsons*, Kelley and his colleagues have found that different brain regions spark with activity when a person gets a joke versus when he or she reacts to it.

"Humor is a significant part of what makes us unique as human beings," says Kelley, a neuroscientist at Dartmouth College in Hanover, N.H. He presented his group's brain-imaging data last week at the Society for Neuroscience meeting in Orlando, Fla.

Despite humor's appeal, few researchers have studied its neural basis. Last year, a British group described the brain activity of people listening to real jokes and puns and to nonsense versions.

Seeking a more natural study of humor, Kelley's group initially had a dozen or so self-professed fans of *Seinfeld* watch an episode—the one in which George seeks a baldness remedy from China. Meanwhile, a magnetic resonance imaging machine continuously scanned their brains for nerve-cell activity. Ultimately, the scientists analyzed the data for the few seconds before and after each joke, as indicated by the show's laugh track.

As a participant viewed something funny, regions of the brain's left hemisphere—the posterior temporal cortex and inferior frontal cortex—initially crackled with activity. Neuroscientists have previously associated these regions with resolving ambiguities, says Kelley.

A few seconds later, presumably as the person responded to the humor, brain regions called the insula and amygdala became active across both hemispheres of the brain. The insula plays a role in emotional sensations, while researchers usually link the amygdala to memory processing. "You tend to recall the funny bits" of a sitcom, notes Kelley.

Studying the brain's response to humor is a challenge, and Kelley's effort is innovative, says Ralph Adolphs of the University of Iowa College of Medicine in Iowa City. "It seems that actually watching a full-length episode [of a sitcom] is going to elicit humor in a more realistic, intense fashion than if you just read or hear a punch line in a lab," says Adolphs.

Concerned that the laugh track on *Seinfeld* influenced study volunteers' reactions, Kelley and his colleagues repeated their experiment with an episode of *The Simpsons*, which doesn't use recorded laughs. "We observed a near-identical pattern of [brain] activation," says Kelley. —J. TRAVIS

Attack of the Clones

Immune cells single out melanoma tumors

Because cancer arises from a person's own cells, it's often overlooked by the immune system. In the past decade, however, scientists have discovered that some immune system cells do indeed recognize tumor cells. There's still a problem: Being few in number, these cells are typically ineffective in fighting cancer.

Scientists can extract these potential fighters from cancer patients. Then they culture the rare cells, which are a type of T cell, to greatly expand their number. Two new studies indicate that when these multiple copies, or clones, of T cells are injected into the patients, they sometimes put the brakes on cancer.

One team of scientists treated 13 patients who had melanoma that had spread, or metastasized, to lymph nodes or internal organs. For each patient, the researchers made billions of copies of the individual's T cells that target a specific protein on melanoma cells, says Steven A. Rosenberg, chief of surgery at the National Cancer Institute in Bethesda, Md.

He and his colleagues gave the patients drugs that kill off their white blood cells, including T cells, before injecting them with the cloned T cell hoard. The team also provided the patients with interleukin-2, a compound that induces T cell growth. The injected T cell clones soon dominated the participants' immune system, even after the other cells rebounded from the drugs' effects, Rosenberg notes.

The treatment beat back the cancer in six of the patients for periods ranging from 2 to 24 months. In each of four other patients, some tumors grew and others shrank, the team reports in the Oct. 25 *Science*.

One 18-year-old patient's cancer, which had spread to lymph nodes in his pelvis and elsewhere, has been in remission for 24 months since treatment. "This is as close to a miracle as I've seen as a clinician," Rosenberg says.

In the other study, Seattle scientists similarly extracted and multiplied T cells from 10 patients fighting advanced melanoma.

These patients didn't get drugs to kill their white blood cells and received less interleukin-2 than Rosenberg's patients did, says Cassian Yee, an immunologist at the Fred Hutchinson Cancer Research Center in Seattle. After the treatment, Yee's patients had a much lower ratio of T cell clones to total T cells than patients in the other study did.

The Seattle patients also showed less dramatic results. Cancer stabilized in half of them for periods ranging from 3 to 21 months, but none of these patients showed actual cancer regression, Yee and his colleagues report in an upcoming issue of the *Proceedings of the National Academy of Sciences*. Yee's patients, however, showed fewer side effects than Rosenberg's patients did.

In the upcoming *Proceedings*, molecular biologist Drew Pardoll of the Johns Hopkins University Medical Institutions in Baltimore says that these two studies indicate that T cells revved up with interleukin-2 "are indeed capable of trafficking into even large metastatic tumor deposits and eliminating tumor cells."

"This is a novel approach that takes advantage of T cells' inherent ability to undergo proliferation," says Charles D. Surh, an immunologist at the Scripps Research Institute in La Jolla, Calif. He suggests that in future experiments, researchers expand populations of T cells targeted toward several proteins found on tumor cells rather than toward just one protein. —N. SEPPA

Hidden Costs

It takes much stuff to make one tiny chip

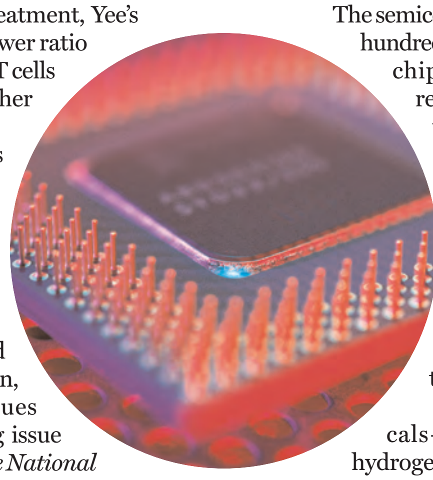
Despite their diminutive stature, the world's microchips levy a high toll on the environment. From an unprecedented analysis, researchers have found that the creation and use of a single 2-gram chip requires at least 72 g of chemicals, 1.6 kilograms of fossil fuel, and 32 kg of water.

Microchips' combination of small size and high value can leave the impression that they offer large benefits with little environmental impact, the scientists remark in an upcoming issue of *Environmental Science & Technology*. It's a misleading notion, they argue.

"The public needs to be aware that the technology is not free," says coauthor Eric Williams of the United Nations University in Tokyo. "The environmental footprint of the device is much more substantial than its small physical size would suggest."

For their analysis of the chip-making process, Williams and his coworkers collected reams of data on the production of memory chips from an unnamed semiconductor firm, industry organizations, technical literature, and other studies.

The semiconductor industry uses hundreds of chemicals to make chips, the researchers report. They calculated that 1.3 kg of fuel and chemicals go into a 2-g chip's production and another 0.4 kg into its use. These figures are conservative, says Williams. "We think the real number is maybe twice that," he adds.



REALITY CHECK A microchip is costlier than it looks.

Some of the chemicals—including caustic hydrogen fluoride and deadly arsine gas—are toxic, and the fossil fuel consumed contributes to global warming, says Williams. Further, manufacture of a chip requires so much water that it may strain local resources.

"The fact that a computer chip has such a short life span, because the technology turns over so quickly, exacerbates the environmental impact," Williams adds.

Analysts familiar with assessments of products' life cycles and environmental impacts may not be surprised by the large values, says H. Scott Matthews of Carnegie Mellon University in Pittsburgh. Not so for the public. "There's certainly a perception gap," Matthews says. Getting people to think about these hidden costs is the goal of such assessments, he notes. —J. GORMAN

SOMETHING NEW ON THE SUN

Innovative telescope homes in on sunspots

BY RON COWEN

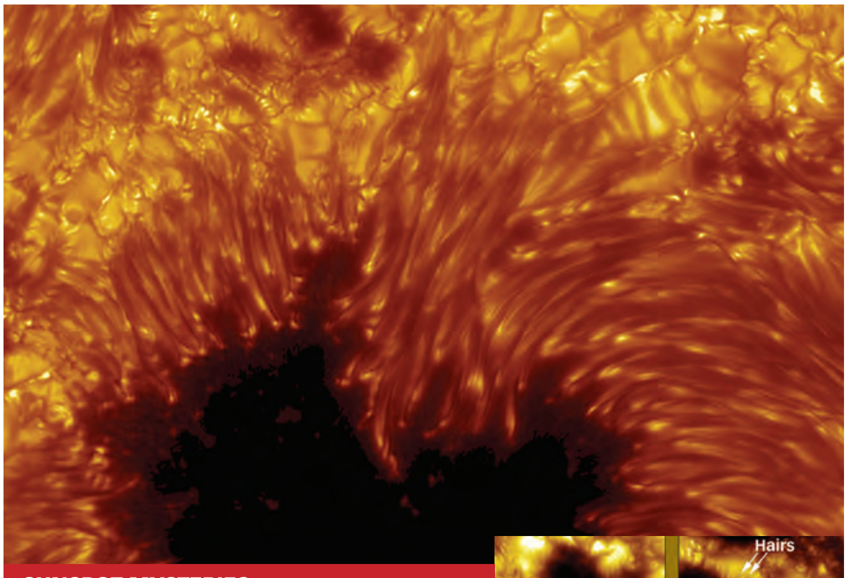
The sharpest-ever visible-light images of the sun are revealing puzzling new features about sunspots, the dark regions where the sun's powerful magnetic field is concentrated. The pictures are the first to show sun structures as small as 90 kilometers in diameter. "These images take the study of sunspots into a new regime," says Thomas R. Rimmele of the National Solar Observatory in Sunspot, N.M. They've also revealed new features, some of which can't be readily explained by any existing model of how sunspots work.

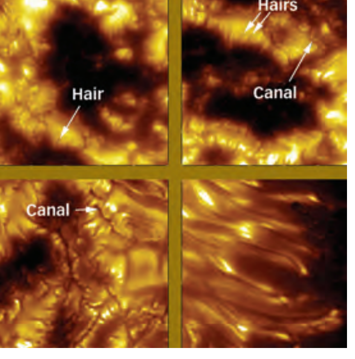
The scientists used the Swedish 1-meter Solar Telescope on La Palma in the Canary Islands. Operating since May, it ranks as the world's sharpest eye on the sun. To achieve its exquisite sharpness, the telescope uses an adaptive-optics system, which corrects for the blurring effects of Earth's turbulent atmosphere. Nineteen elements of a pliable mirror within the telescope flex 1,000 times each second to adjust for rapid changes in the air above it.

The solar telescope has recorded both strange and familiar features within the Earthsize sunspots, which can have magnetic fields 5,000 times stronger than Earth's. Intense magnetic fields within these huge blemishes can belch flares and clouds of ionized gas that can damage electrical power systems and Earth-orbiting satellites (*SN: 11/17/01, p. 310*). Therefore, astronomers have been eager to learn more about sunspots.

Sunspots are cooler and darker than the rest of the sun's surface because their magnetic fields impede hot gases from rising to the surface and radiating away their heat. The darkest, central region of a sunspot, called the umbra, features tightly bundled magnetic field lines. Long, thin filaments radiate from the umbra into a brighter surrounding region called the penumbra. These field lines diverge from the umbra like a bundle of wheat stalks splaying outward from the tie that binds them.

The bright filaments, which range from 150 to 180 km in diameter, may represent places where flowing gases have been heated by the magnetic fields or where some of the roiling gases from the interior have risen to the surface, says study coauthor Dan Kiselman of the Royal Swedish Academy of Sciences in Stockholm.





SUNSPOT MYSTERIES — The sharpest image of the sun ever taken (above) shows part of a large sunspot recorded July 15. Filaments surround a dark center. Some of the bright filaments contain dark cores, which had not been previously observed. Other new sunspot features appear in panels at right. Three panels show small sunspots with thin dark lines, dubbed hairs, and thicker dark lines, called canals, in the surrounding solar surface. The fourth panel (bottom right) shows sunspot filaments with dark cores.

SCHARMER ET AL./NATURE

Theorists suspect that the penumbra is key to keeping a sunspot intact. But penumbra images had been too fuzzy to reveal internal structure.

With the Swedish telescope, researchers have obtained images that clearly resolve the filaments. Surprisingly, many of the bright filaments have dark cores, report Kiselman, Göran B. Scharmer, and their colleagues in the Nov. 14 *Nature*.

"This is the kind of result that scientists groan about but love to see because it sends everyone back to the drawing board," says Craig DeForest of the Southwest Research Institute in Boulder, Colo.

Scharmer and his team speculate that the dark cores might actually be cooler, denser gas that lies above the other gas in the filaments. Alternatively, the cores could be the central parts of gaseous tubes sculpted by magnetic field lines.

The researchers also describe new sunspot structures that they call hairs and canals.

"Our hope is that the new data will test and weed out sunspot models," Kiselman says. Measuring the magnetic field strength and velocity of gas in the filaments' dark cores may reveal yet more details on how the sun got its spots. ■

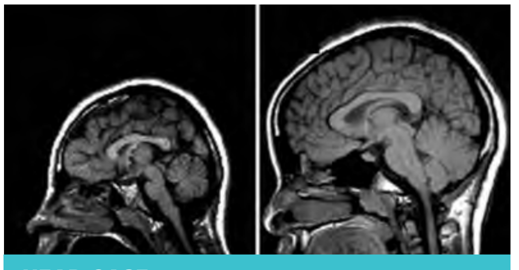
SIZING UP THE BRAIN

Mutations that produce small brains may reveal how human intelligence evolved

BY JOHN TRAVIS

In the 1960s, Pakistan built a mammoth dam on the river Jhelum to generate electric power and store water for irrigation. Known as Mangla, the dam created an upstream lake that displaced about 20,000 families from the district of Mirpur. Around the same time, England's textile industry was facing a major shortage of skilled laborers, especially in the county of Yorkshire. Many of the people from Mirpur who were displaced by Mangla traveled to Bradford and other Yorkshire districts.

The coincidental timing of the dam's construction and Yorkshire's need for workers has, nearly 4 decades later, provided scientists with insight into how the human brain develops and, possibly, into how it evolved from the smaller brains of our hominid ancestors. A few years ago, a physician from St. James' University Hospital in Leeds, England, noticed something unusual among the Pakistani families he examined at a Bradford clinic. "I was seeing a lot of children who had microcephaly with moderate mental retardation but no other disease features," recalls clinical geneticist C. Geoffrey Woods.



HEAD CASE — These scans show the smaller brain of a 13-year-old girl with microcephaly (left) the normal brain of an 11-year-old girl (right).

C. WOODS/NATURE GENETICS

Microcephaly is a rare condition characterized by an abnormally small head, the result of an undersized brain. In particular, the cerebral cortex—the layers of nerve cells that cover the brain's surface and are the seat of higher reasoning—is shrunken. "The cerebral cortex is the part of the brain that, for better or worse, makes us human," notes Christopher A. Walsh, a Howard Hughes Medical Institute (HHMI) investigator at Harvard Medical School in Boston. "Children who have abnormal development of the cerebral cortex fail to achieve the kind of talents we pride ourselves on, such as language."

Intrigued by his patients with microcephaly, Woods began studying the DNA of Pakistanis with the condition and their unaffected relatives. He and his colleagues gradually realized that there isn't just one gene that causes microcephaly when mutated; there are at least six genes. This year, the researchers identified two of the genes, including one responsible for microcephaly in about half of the nearly 60 Pakistani families studied to date.

These two genes, as well as another one studied by Walsh's group (see box, page 314), are shedding light on how the cerebral cortex forms. Moreover, by pinpointing genes that seem to regulate the size of the cerebral cortex, the scientists have set the stage for studies into what genetic changes produced the rapid expansion of the cerebral cortex as primates, including humans, evolved. Indeed, one of the human-microcephaly genes is dramatically different from its counterparts in much simpler animals such as worms and mice.

"I suspect there may be many things that contribute to the increased size of the primate cortex, but the microcephaly genes are a fascinating beginning," says Martin Raff of University College London, who studies regulation of nerve cell division.

BRAIN'S BLACK BOX Containing billions of nerve cells, the cerebral cortex is the largest structure of the human brain. Essentially a flat sheet not much thicker than an orange peel, the cortex folds and refolds into the familiar deep creases of the brain's surface. The cerebral cortex varies in size dramatically among species. It "mostly grows by becoming a larger sheet rather than a thicker sheet," says Walsh.

The human cortical surface area is about 1,000 times greater than that of the mouse, for example. And compared with the cortex of the chimpanzee, our closest living relative, the human cerebral cortex has three to four times more surface area. Some scientists attribute the greater intelligence of modern humans to the rapid expansion of the cerebral cortex as hominids evolved.

In microcephaly, the cerebral cortex grows unusually slowly and reaches a size no bigger than that of early hominids. Various circumstances, such as prenatal infections or a mother's alcohol abuse, can produce microcephaly, but they usually also generate other physical abnormalities. In so-called primary microcephaly, the small brain and head are the only obvious physical defects. The brain's basic architecture is preserved, albeit in a smaller form. In such cases, the child or adult is mentally retarded but has no other apparent neurological problems, such as seizures.

Primary microcephaly typically occurs when a mother and a father each pass on a mutated copy of a gene that controls brain size. Since among the families that migrated to England from Mirpur, cousins often married each other, so the chances that a baby would have two mutated copies of a gene increased. That explains the abundance of microcephaly cases that Woods saw.

In work led by Andrew P. Jackson of St. James' University Hospital in Leeds, the investigators tracked down one microcephaly gene by focusing on two Pakistani families that had an unusually large number, seven in total, of members with microcephaly. In the July *American Journal of Human Genetics*, Jackson, Woods, and their colleagues report finding mutations in a novel gene in affected family members but not in unaffected ones. They named the gene *microcephalin* and, by studying human and mouse fetal tissue, showed that the gene is active in the cerebral cortex as it develops before birth.

The protein encoded by *microcephalin* has several features seen in other proteins, but how the molecule regulates size of the cerebral cortex remains unclear. "Unfortunately, the gene doesn't have a specified function yet. It's been a bit of a black box," says Woods.

Continued on page 314

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Also murky is whether the gene played an evolutionary role in the expansion of the cortex. The DNA sequences of the mouse and human gene do differ, but not in a way that offers an obvious explanation for the brain sizes of the two species. "We need to sequence the primate versions of *microcephalin* to get a better handle" on the gene's evolution, says Woods.

IQ TEST The gene *microcephalin* so far accounts for the small-brain disorder in only a few of the Pakistani families. A much more provocative story has emerged from the second reported identification of a gene for primary microcephaly. It's the human version of a gene called *asp*, which stands for abnormal spindle. Originally studied in fruit flies, this gene encodes a protein associated with cell division. When a cell divides, two networks of fibers form, each one pulling a set of chromosomes into one of the two daughter cells. In flies with *asp* mutations, these networks, called spindles, don't work as well as normal, and the overall rate of cell division is lowered.

In the October *Nature Genetics*, Woods and his colleagues report that in about half of the Pakistani families studied, the members with microcephaly had mutations in both copies of the human version of *asp*. While the fly gene is active throughout the insect body, the human and mouse version turns on just in the fetal brain, specifically in progenitor cells of the cerebral cortex. Woods speculates that the gene's protein somehow keeps these cells dividing. If the protein is missing or mutated, the progenitor cells may not divide as often as normal, leading to an undersized cortex.

When comparing the fly, worm, mouse, and human versions of *asp*, the researchers noticed something remarkable. The proteins encoded by each gene have multiple copies of a stretch of amino acids called an IQ domain—the name derives from the scientific notation for two amino acids, isoleucine (I) and glutamine (Q), present in the domain. The number of IQ domains in the protein differs considerably from one species to the next. The worm, fly, mouse, and human proteins have 2, 24, 61, and 74 IQ domains, respectively.

"The protein is physically larger in species with larger brains," he says. "As your IQ gets higher, you have more and more of these IQ repeats." This is particularly odd, adds Walsh, given that no other known protein has more than five or six IQ domains.

Although this discovery suggests that as *asp* encoded more and more IQ domains species evolved to have larger and larger brains, the scenario puzzles Woods. "It's difficult at the moment to make a model of why the number of IQ domains should affect the size of the brain," he admits.

To examine the evolutionary questions surrounding this microcephaly gene, the investigators intend to deactivate the mouse version and see whether that produces animals with small brains. They may also replace the mouse version with the human gene and observe whether big-brained rodents result.

Furthermore, Woods and Walsh have started to sequence the *asp* gene in chimpanzees. "If they have exactly the same gene as us, then, while it's clearly important for brain development, it isn't the step that has made our brain three times bigger than higher primates," says Woods.

Bruce Lahn, an HHMI investigator at the University of Chicago, is looking for genes that drove human-brain evolution. He agrees that the newly identified microcephaly genes cry out for further study. Still, Lahn cautions against prematurely crediting the genes for the human brain's impressive cerebral cortex.

"Very little, if anything, is known about the genetic basis of brain evolution. It's a complete blank slate," he says. "It's not too far out to speculate that evolution may have played on these genes to select for a larger brain. The caveat is that there are many such genes. It takes thousands, if not tens of thousands, for the brain to develop properly." ■

A Wrinkle in Mind

Genetically engineered mice develop enlarged, humanlike brains

If a human brain and a mouse brain were sitting next to each other, the first thing you would notice is the difference in size. The second most obvious difference is that folds and furrows mark the surface of the human brain, while the surface of the mouse brain is smooth. The wrinkled portion of the human brain is the cerebral cortex, the multilayer region responsible for making sense of all the information streaming into a person's head. In people, nonhuman primates, and other mammals with relatively large brains, the cerebral cortex's convolutions permit its large surface area to cram inside the skull.

Christopher A. Walsh of Beth Israel Hospital in Boston compares the process to crumpling up a large sheet of paper so that it fits inside a small container. "As the cortex gets to a certain size, [it] starts developing these wrinkles. The bigger the cortex gets, the more wrinkles it gets," he says.

In the July 19 *Science,* Walsh and his colleague Anjen Chenn, now at Northwestern University School of Medicine in Chicago, described genetically engineered mice that develop cerebral cortexes with greatly increased surface area, so much so that the mouse brains have a more humanlike, wrinkled appearance. "It looks as if these wrinkles don't require any special genetic tricks. It seems to be a passive response to having a brain that's bigger than your head," says Walsh.

To create the mice, the two researchers modified a gene encoding a protein called beta-catenin. This protein had drawn their interest because it regulates cell division in many tissues. In some cases of brain cancer, for example, beta-catenin drives unchecked cell proliferation. Adding to Chenn and Walsh's interest, the beta-catenin gene is active in the pool of brain-progenitor cells in which the nerve cells of the cerebral cortex originate.

In normal circumstances, beta-catenin breaks down quickly in cells once enzymes attach phosphate groups to the protein. Chenn and Walsh altered the protein's gene so that it encodes a version of beta-catenin lacking some sites to which the phosphate groups stick. "It's broken down much more slowly," says Walsh.

The resulting beta-catenin accumulation seems to enable the cerebral cortex's progenitor cells to divide extra times before maturing into nerve cells, ultimately increasing the size of the cortex. The mutant mice had brains two to three times as big as normal. "It shows how you can regulate the size of the cortex fairly dramatically by controlling one simple [genetic] switch," notes Walsh.

The large-brained mice didn't survive past birth, but the researchers don't know why. More recently, Walsh's research group tweaked the beta-catenin gene so that the mouse brains enlarge to just about 40 percent greater than normal. These rodents survive and seem healthy, although they're a bit more aggressive than normal. The researchers haven't yet evaluated whether these big-brained mice are smarter than the average mouse.

Walsh now plans to investigate whether beta-catenin plays a role in human conditions marked by abnormally large or small brains. He's also curious about whether the cerebral cortex–size differences among species may stem, at least in part, from varying activity of the beta-catenin gene. "That's a much harder question" to answer, he says. —J.T.

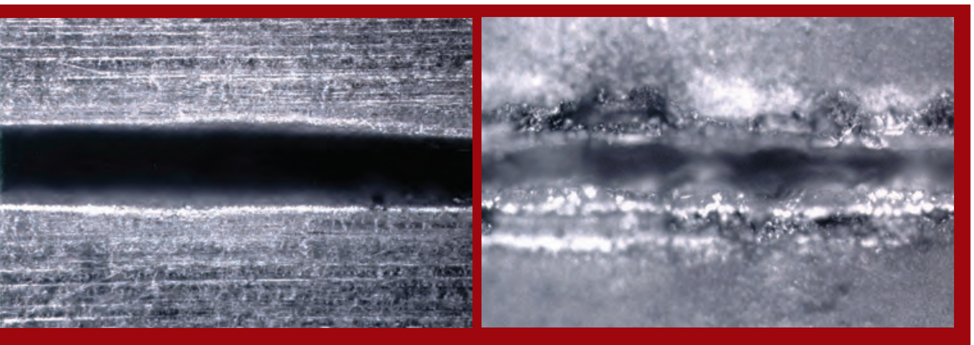
HOT FLASHES, COLD CUTS

Ultrafast lasers give power tools a new edge

BY PETER WEISS

Andrei V. Rode didn't flinch recently when enough power to run 2,000 homes blasted his fingertip. Although staccato bursts of laser light vaporized tiny dots of his flesh, he kept his finger in harm's way. Rode, a physicist at Australian National University in Canberra, was testing something he'd been told: That the lasers he works with blast materials in such a novel way that they can evaporate his tissue without any pain.

As the cut in his finger deepened and he felt no discomfort, Rode became convinced. When the blood started to flow, he yanked his finger away. His experiment had given him a first-hand experience of a remarkable physical process that physicists first stumbled upon several years ago.



CHANGE THE CHANNEL — An ultrafast-pulse laser cuts a clean channel (left) in aluminum whereas a longer pulsed laser causes melting and irregular solidification of the metal (right).

B. STUART/LAWRENCE LIVERMORE NATIONAL LABORATORY

At that time, scientists had just developed the means of creating light pulses of unprecedented brevity but enormous power. They had also found that, by a never-before-seen interaction between light and matter, those pulses were damaging the very laser setups that produced them. The hallmark of this activity was the total annihilation of a chunk of matter with virtually no effect on the material surrounding it.

Investigators found that holes made by the speedy lasers looked preternaturally round. Likewise, where the beams made cuts through a material such as aluminum, the edges looked oddly untouched, with no slag, burrs, cracks, or other signs that something had blasted out the atoms just nanometers away.

Although lasers had long been used for machining, none had ever worked materials so cleanly or with such finesse. "The physics of the process is dramatically different," says Michael D. Perry of General Atomics in San Diego.

Laser researchers quickly realized that one of the most powerful and precise devices ever invented for sculpting materials might be in their hands. At once both delicate and brutal, the pulses can bore holes as small as a few hundred nanometers across. Ultrafast beams "slice through diamond like butter," Perry says. Yet biomedical specialists can also use them as super-accurate scalpels for vision-correcting operations—and even for pinpoint surgery on individual cells.

BEAM ME UP . . . AND AWAY Physicists have studied how lasers damage surfaces since the 1960s. When a laser pulse strikes, the rippling electric and magnetic fields of its light waves shake any unattached electrons back and forth (*SN: 1/22/00, p. 55*). Ordinarily, those electrons bump into nearby atoms and pass their energy to them as heat, which on a microscopic scale is the mechanical vibration of atoms. This heat can vaporize the material that the laser beam hits.

However, a pulse lasting 10-trillionths of a second or more, which is long by laser standards, can have a more widespread effect. The sudden, thermal expansion of the irradiated material can launch a damaging shock wave into the surroundings.

That's not all. Excess heat also surges beyond the irradiated region, and it singes, melts, or otherwise alters material on the perimeter.

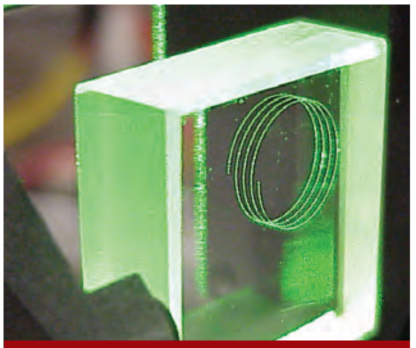
By the mid 1990s, scientists were building powerful lasers whose pulses were measured not in billionths or even trillionths of seconds but in thousandths of trillionths of seconds, or femtoseconds. Such time ticks are astoundingly brief. In one second, there are more femtoseconds than there have been hours since the universe began roughly 14 billion years ago. The new lasers became variously known as ultrashort-pulse lasers, ultrafast lasers, or simply as femtosecond lasers.

In the lingo of physics, a device's power is greater the quicker it transfers energy. So, even a bench-top laser that delivers only enough energy per short pulse to excite a few water molecules can still be astonishingly powerful. Because their pulses are so brief, some of the new, femtosecond lasers are rated equal—for a fleeting instant—to all the world's power plants put together.

When scientists looked at the damage caused by such pulses, they saw surprisingly clean, crisp cuts and holes—unlike anything they'd previously observed in laser interactions with matter.

What was happening, they realized, was that electrons energized by the pulse were knocking other electrons loose, and those, in turn, were quickly freeing up yet more electrons. However, this cascade of electron release was taking place too fast for the electrons to transfer their energy to atoms as heat.

Next, because the newly freed electrons electrically repelled each other, they exploded away from the surface. In turn, that outsurge of negative particles pulled along, by electrostatic attraction, the positively charged ionized atoms that had been created by the cascade of electron liberation.



FOLLOW ME — Inside a glass block, green light loops through a helical channel of modified glass created by extremely brief, intense laser pulses.

Before heat or shock waves could propagate into the surroundings, the laser-blasted material had vanished.

PRECISION WORK

Since the discovery of this novel destructive process, researchers have rushed to take advantage of it. Automakers and heavy-equipment manufacturers, for instance, are investigating the lasers' use as tools for drilling better fuel injectors for engines. However, a veil of secrecy shrouds that and many other works in progress. "A lot of that stuff just isn't talked about," notes femtosecond-laser scientist Peter P. Pronko of the University of Michigan in Ann Arbor.

A notable exception is a system built and used by IBM. Ultrashort-pulse laser processing now serves a vital function in the manufacture of every microchip that the electronics giant sells.

At one stage in the complex microcircuit-production process, chipmakers project light through stencil-like masks to create microscopic patterns in a light-sensitive coating on the chip. The finer the detail in those mask patterns, which are printed in chromium on thin plates of glass, the more electronic components can be crammed onto a tiny fleck of silicon.

Richard A. Haight, Peter Longo, and Alfred Wagner of IBM's Watson Research Center in Yorktown Heights, N.Y. have developed a femtosecond-laser-based system that knocks out mask-destroying spots of misplaced chromium. Earlier systems that used nanosecond lasers to clean up those spots sometimes spattered chromium onto other parts of the mask or pitted its glass. "The problem was you could cause more defects than you were correcting," Haight says.

The new mask-repair system focuses its laser to a finer spot size than an earlier version did and therefore can make more precise corrections. In use since the beginning of the year, the device corrects defects in virtually all the photomasks IBM makes—thousands per year. Haight described the device at the Optical Society of America meeting in Orlando, Fla., on Oct. 2.

Because cutting by femtosecond lasers propagates almost no heat, the beams can safely slice through most high explosives, researchers at Lawrence Livermore (Calif.) National Laboratory have found. Longer-pulse lasers ignite the materials. Livermore's Frank Roeske says that femtosecond lasers have promise as a cold process for dismantling retired rockets, artillery shells, and other weapons.

Besides leaving adjoining material structurally intact, femtosecond-laser pulses don't provoke chemical changes. This noninvasive aspect of femtosecond lasers may lead to an improved type of stent, a medical device that holds open plaque-choked arteries (*SN: 11/24/01, p. 328*).

Biodegradable stents can prevent the now common problem of arteries renarrowing some time after an operation that unclogs them. However, mechanical tools are too rough to cut stents from delicate biodegradable polymer tubes, and long-pulse lasers melt or spoil the biocompatibility of the material. New experiments show that femtosecond lasers can slice through the fragile polymer without altering its critical biochemical properties, Thorsten Bauer of Laser Zentrum Hannover (LZH) in Germany and his colleagues reported at the Photonics West-LASE 2002 meeting in San Jose, Calif., last January.

An even lighter touch is evident in recent work that demonstrates the femtosecond laser's potential for gene therapy. In the July 18 *Nature*, Uday K. Tirlapur and Karsten König of Friedrich Schiller University in Jena, Germany, described vaporizing tiny spots in the membranes of rodent cells immersed in a solution containing the gene for a fluorescent protein. The cells quickly repaired the holes—but not before the genes had apparently sneaked in, yielding cells that appeared normal except for their green glow.

INSIDE JOB While the brevity of femtosecond-laser pulses makes them remarkably accurate tools for machining, that's only half the story. Because of their extraordinary intensities—the high number of photons per second they can concentrate into a small area—the pulses also affect materials that are transparent.

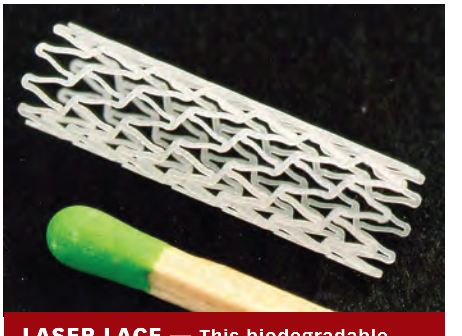
In clear substances such as diamond and corneal tissue, most electrons are locked up in chemical bonds. Unless a photon has enough energy to liberate an electron, the light won't be absorbed. The lack of free electrons prevents the electron-dependent processes by which lasers heat up or vaporize matter.

However, in a femtosecond-laser pulse, the photons are so densely crammed together that bound electrons are likely to get hit by two or more photons at once. Suddenly, there's plenty of energy for booting electrons out of atoms, and the material no longer lets the light pass through.

By focusing the beam to a certain depth, laser operators can choose how far inside a transparent material the pulse should penetrate before it exceeds the threshold at which multiphoton ionization kicks in. Then, the process quickly sparks an electron avalanche vaporizing everything within the laser spot. "You can actually machine inside a material and not affect its surface at all," says Duncan P. Hand of Heriot-Watt University in Edinburgh.

In experiments demonstrating how potent this multiphoton ionization can be, researchers have carved cavities into the diamonds used as the jaws of materials squeezing anvils for high-pressure experiments. Ho-Kwang Mao of the Carnegie Institution of Washington (D.C.) says he aims to insert electronic sensors inside those cavities to improve measurements of the nearby pressurized samples.

Other scientists are developing ways of exploiting multiphoton ionization in fields ranging from telecommunications to ophthalmology. For example, Philippe Bado and his coworkers at the start-up company Translume in Ann Arbor, Mich., have developed a technique for using the femtosecond laser pulses to make optical components for sensors and telecommunications. A prototype machine vaporizes channels within domino-size blocks of glass. Longer pulses would deliver too much energy, cracking the glass, Bado says.



LASER LACE — This biodegradable polymer stent cut by an ultrafast laser expands inside a clogged artery to prop it open and improve blood flow.

TRANSLUME; BAUER/LASER ZENTRUM HANNOVER

When the vapor resolidifies, the channels have slightly altered optical properties compared to the surrounding glass. Because of that mismatch, the channel becomes a waveguide, conducting light like an optical fiber. Waveguides increasingly carry out important functions in communications networks, such as receiving multiple wavelengths of light in one channel and sending them out along separate paths, Bado says.

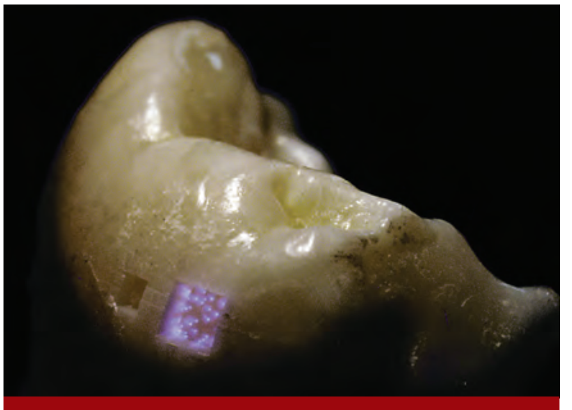
In a medical application that requires cutting transparent tissues, femtosecond lasers are finding use in the vision-correcting procedure known as LASIK (*SN: 7/19/97, p. 44*). In the conventional operation, doctors cut open a flap of tissue at the front of the eye with a scalpel that acts like a carpenter's plane. Then they use nanosecond-pulsed lasers to smoothly shape the underlying corneal tissue.

By making that first cut instead with a femtosecond laser, surgeons can both make a more accurately shaped flap and also reduce the chance of certain post-surgical complications, says Ronald M. Kurtz of the University of California, Irvine. Those complications include tissue abrasions and excessively thin flaps that wrinkle up.

To make the slice, the femtosecond laser points directly into the patient's eye and moves in a spiral pattern. During that motion, it blasts thousands of tiny spherical cavities in the cornea, all along the same plane. Perforated by the many bubbles, the clear flesh separates at that plane and can be folded back.

In the past year, Intralase of Irvine, Calif., a company cofounded by Kurtz, has sold about 40 femtolaser systems to clinics nationwide. They have used the devices to perform more than 20,000 procedures, Kurtz says.

Eventually, femtosecond lasers may be used for all phases of LASIK surgery, says LZH's Holger Lubatschowski. He and his colleagues, working with the company Carl Zeiss Meditec of Jena, Germany, have developed a system that fires shorter, less energetic pulses along a novel cutting trajectory. By creating smaller bubbles, the new system makes such smooth slices that it could both cut the flap and shape the underlying cornea, Lubatschowski claims. The researchers plan to start clinical studies early next year.



T. THOMPSON/AUSTRALIAN NATIONAL UNIVERSITY

PHOTON DRILL — Ultrafast laser pulses unleash bursts (blue flashes) of ionized tooth tissue.

HARD FUTURE Femtosecond lasers are delicate enough for eye surgery because their high-power, but low-energy pulses only take little nips of materials. For instance, when Rode did his finger-blasting experiment, the laser firing a thousand times per second took nearly 30 seconds to draw blood. For machining harder materials, today's femtosecond lasers are even slower.

For example, in a recent study of the lasers' potential for dentistry, Rode and his colleagues found that ultrafast pulses could remove bits of tooth without affecting surrounding material. The researchers expect ultrafast-laser dentistry to be painless and protect nearby healthy enamel.

However, the removal rate has to speed up by a factor of 100 or so for the lasers to compete with mechanical drills, Rode says. The team reported its findings in the Aug. 15 *Journal of Applied Physics.*

Laser specialists say that other promising uses of femtosecond lasers, such as drilling fuel-injector nozzles in steel, are being held back because today's lasers are too slow and too costly. However, laser makers report that they're developing even better designs that may soon make it possible to boost the pulse rate 100- to 1,000-fold and to make simpler, more reliable units. "In the near future, these systems will be getting much smaller and less expensive," Lubatschowski predicts.

Once that happens, many more items in the world—from teeth to car engines—are going to get blasted into better shape, tiny bit by tiny bit. ■

OF NOTE

BIOMEDICINE

Duct tape sticks it to warts

Treating a wart with a covering of duct tape seems to be more effective—and less painful—than removing the wart by freezing it with liquid nitrogen.

Researchers at the Madigan Army Medical Center in Tacoma, Wash., instructed 26 children and young adults to cover their warts with a piece of duct tape for 6 days a week. The physicians directed another 25 patients to come into the clinic to get cryotherapy every 2 to 3 weeks.

Warts on 22 of 26 people using duct tape disappeared within 2 months, the researchers report in the October *Archives of Pediatric and Adolescent Medicine.* Among patients getting cryotherapy, 15 of 25 said that their warts went away. The most common side effect of duct-tape therapy was skin irritation, but some people treated with cryotherapy had pain and burning.

The therapies probably work the same way, says lead researcher Dean R. Focht III, now at Cincinnati Children's Hospital Medical Center. They both induce irritation around the wart, thus triggering an immune reaction against the virus that causes warts. —D.C.

ASTRONOMY

Another moon for Uranus

Astronomers have confirmed the existence of the 21st moon known to be orbiting Uranus. Dubbed S/2001 U1, the satellite is one of six small Uranian moons that have elliptical orbits and don't move in the same plane as the planet's larger moons. Ranging from 10 to 20 kilometers in diameter, these so-called irregular moons seem to have been created by collisions between larger bodies during the formation of the planets.

Because S/2001 U1 is faint and lies at a great distance from Uranus, astronomers had to use several telescopes to confirm its status as a moon.

The first sighting was in August 2001 by a team led by Matthew J. Holman of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., and J.J. Kavelaars of the Dominion Astrophysical Observatory in Victoria, British Columbia, with a telescope at the Cero Tololo Inter-American Observatory in La Serena, Chile. Christophe Dumas of NASA's Jet Propulsion Laboratory in Pasadena, Calif., and Philip Nicholson of Cornell University did follow-up observations at Palomar Observatory near Escondido, Calif. Astronomers also tracked S/2001 U1 using one of the European Southern Observatory's 8-meter telescopes in Paranal, Chile.

Dumas and his colleagues reported their findings in a Sept. 30 circular of the International Astronomical Union. —R.C.

OF NOTE

ASTRONOMY

Europa's freckles

Reddish spots and shallow pits that pepper the surface of Jupiter's moon Europa may mark regions where warmer and less dense ice, possibly from an ocean buried deep beneath the moon's frigid surface, percolates to the surface.

The spots and pits, each about 10 kilometers in diameter, run across the northern hemisphere of Europa, according to a new analysis of images taken in 1996 and 1998 by the Galileo spacecraft. Dubbed lenticulae, the Latin word for freckles, the uniformly spaced and sized spots suggest that Europa's surface is a thick ice shell floating atop an ocean.

POCKMARKED Reddish spots and shallow pits on Jupiter's moon Europa.

The shell "acts like a planetary lava lamp, carrying material from near the surface down to the [proposed] ocean" and causing material from the ocean to rise to the surface, suggests Robert T. Pappalardo of the University of Colorado at Boulder.

The warm ice that rises to the surface and forms the freckles may reveal the composition of the proposed subsurface ocean and whether it has the ingredients to support life. Even marine organisms that rise to within a few kilometers of the surface could survive, Pappalardo says. If this so-called thick-shell model of Europa is correct, then future spacecraft won't have to drill all the way through the estimated 20-km-deep ice shell to search for life in an underlying ocean.

Pappalardo presented the findings Oct. 27 at a meeting of the Geological Society of America in Denver. —R.C.

IMMUNOLOGY

Immune protein may stall HIV

People who don't get AIDS despite harboring the human immunodeficiency virus (HIV) for years are more likely than AIDS patients to also have plenty of perforin, a protein that is instrumental in killing infected cells, scientists report in the November *Nature Immunology*.

The AIDS virus works by hijacking immune cells called CD4 cells, which disrupts the immune system in most people. Other cells of the immune system, CD8 cells, usually fail to defend against the virus.

But in a small group of HIV-infected people known as long-term nonprogressors, those CD8 cells seem to stave off the development of AIDS, even in the absence of anti-HIV drugs. The difference may be the quality of the CD8 cells, not the quantity, says study coauthor Mark Connors of the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

Connors and Stephen A. Migueles led a research team at the institute that examined blood samples from 40 people with HIV, including 15 nonprogressors. Both groups had similar concentrations of CD8 cells. These cells destroy damaged or infected cells by releasing a torrent of chemicals that take apart target cells. Perforin helps the cell-killing compounds gain entry to target cells, Connors says.

The CD8 cells of long-term nonprogressors produce more perforin than do CD8 cells of HIV-positive people who developed AIDS, the scientists found. Other evidence indicates that nonprogressors produce CD8 cells that orchestrate attacks specifically against HIV-infected cells. Connors considers these findings "pieces in a puzzle" that he hopes will ultimately reveal an exploitable weakness in the virus that causes AIDS. —N.S.

ZOOLOGY

Tadpoles kill by supersuction

Tadpoles of African dwarf clawed frogs catch their prey by a surprising means.

Tadpoles typically work their elaborate, jagged mouthparts over a surface, making a soup of the scrapings. Pumping movements of the mouth cavity gently pull in and filter the resulting slurry.

Researchers discovered something quite different when they turned a high-speed video camera on young *Hymenochirus boettgeri* not quite 3 millimeters in length. These tiny tadpoles rely on a superfast suction technique to catch prey such as minuscule water fleas, say Stephen Deban at the University of Utah in Salt Lake City and Wendy Olson of Dalhousie University in Halifax, Nova Scotia.

SPEED KILLS A tadpole's tubular mouth (arrow) shoots out to capture a brine shrimp.

In the Nov. 7 *Nature*, the researchers report that the tadpoles track each prey individually and then suddenly extend their tube-shaped mouths to suck in the prey within 7 milliseconds. (For video, see http://socrates.berkeley.edu/~deban/hymenomovie.html.)

Although larvae of certain fish also hunt this way, the researchers were intrigued to discover that a quite different animal had evolved the same approach. —S.M.

PHYSICS

Speedy impacts send microwave distress calls

Earth-orbiting space junk zips along so fast that even small pieces striking the International Space Station and other satellites could cause serious damage. Based on laboratory experiments, a Japanese team now reports that these hypervelocity impacts emit microwaves. The finding suggests a new way to remotely detect space-junk hits, say engineers who study such impacts.

Researchers have long known that hypervelocity impacts give off bursts of heat and visible light. Those occur because the kinetic energies of the colliding objects convert rapidly to heat, setting aglow the materials involved. However, earlier attempts to measure other electromagnetic emissions from such impacts produced ambiguous results, says Tadashi Takano of the Institute of Space and Astronautical Science in Sagamihara.

In the new search for a microwave signature of collisions, he and his colleagues equipped a vacuum chamber with an antenna tuned to a midrange microwave frequency, 22 gigahertz. Then they placed aluminum plates of different thicknesses in the chamber and fired bulletlike projectiles of nylon and metal at the plates at speeds of more than 14,000 kilometers per hour.

Within microseconds after each collision, the antenna picked up multiple bursts of microwaves, the scientists say. They present their observations in the Nov. 1 *Journal of Applied Physics*. The pattern of microwave pulses suggests that the emissions may arise from the collapse of metallic-crystal lattices rather than from rapid heating, the researchers speculate.

If other experiments confirm the microwave releases, the phenomenon might provide the basis for simple debris-impact detectors using modified cell-phone equipment, comments Eric L. Christiansen of NASA's Johnson Space enter in Houston. —P.W.

NASA/JPL/U. ARIZONA/UNIV. COLORADO; NATURE

Books

A selection of new and notable books of scientific interest

BAD MEDICINE: Misconceptions and Misuses Revealed, from Distance Healing to Vitamin O

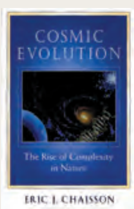
CHRISTOPHER WANJEK

The idea of bloodletting or shock therapy as cures for what ails you seems antiquated and foolhardy. However, Wanjek believes that many people believe in and practice equally bogus medical treatments today. He debunks many common medical myths and misconceptions, including touch therapy, magnet therapy, and the use of shark cartilage to ward off cancer. He also explores the accuracy of medical news on television, our obsessive war on bacteria, and the quest to cure baldness. ***Wiley, 2003, 280 p., b&w photos/illus., paperback, $15.95.***

COSMIC EVOLUTION: The Rise of Complexity in Nature

ERIC J. CHAISSON

If there's one thing that unites the universe, it's that things change. Along an arrow of time starting at the Big Bang, Chaisson depicts cosmic evolution in a wide range of systems: particulate, galactic, stellar, planetary, chemical, biological, and cultural. Over time, all these systems—be they manifested in worms, human brains, or microchips—become both more complex and more ordered as a result of changes in energy densities, according to Chaisson. What is perhaps most provocative here is the author's quantitative method to measure various systems' complexity and graph the curve of cosmic evolution. As time marches on, Chaisson suggests, certain systems will become even more complex than the human mind. Indeed, at the top of his curve of cosmic evolution currently resides the Pentium microchip. Originally published in hardcover in 2001. ***HUP, 2002, 274 p., b&w photos/charts, paperback, $17.95.***



THE GREAT BOOK OF OPTICAL ILLUSIONS

AL SECKEL

This compendium of 280 visual illusions includes classic examples by Salvador Dali and M.C. Escher, as well as newly devised ones. Captions explain what to look for in each picture. There are also details about why these effects occur and how they are consistent with the processes that mediate normal perception. Try to pick out the face of a bearded man amid seemingly nonspecific graphics, watch a woman's closed eyes open, and learn how to make your finger float before your eyes. ***Firefly, 2002, 304 p., color illus., paperback, $24.95.***

LOVE AT GOON PARK: Harry Harlow and the Science of Affection

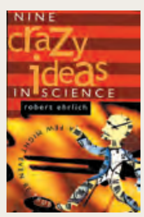
DEBORAH BLUM

In the mid-1960s, many psychologists frowned on affectionate relationships between parents and children, believing that excessive parental attention breeds needy and demanding offspring. In vogue at the time was the Freudian view that the mother-child bond is driven exclusively by a baby's need for food. Harry Frederick Harlow challenged that notion and explored the role of love in human relationships. Today, many people remember him disdainfully for his cruel primate experiments that supported his point of view. Pulitzer prize–winning journalist Blum explores Harlow's legacy and recalls how this man with a sometimes abrasive personality introduced the concept of love as a vital component of what it is to be human. Blum details how Harlow's studies revealed the consequences of abusive relationships and how love and affection can be directly linked to elevated intelligence. Oddly, Harlow didn't practice his own philosophy. Blum also explores Harlow's strained relationships with his own children. ***Perseus Pubng, 2002, 336 p., hardcover, $26.00.***

NINE CRAZY IDEAS IN SCIENCE

ROBERT EHRLICH

Pondering nine theories currently being debated by scientists, politicians, and the public alike, Ehrlich scientifically evaluates each one. He rates each idea on a "cuckoo scale," with one cuckoo denoting feasibility and four cuckoos, probable impossibility. The issues are reflected in the book's chapter titles, including "More Guns Means Less Crime," "AIDS Is Not Caused by HIV," "Nuclear Radiation Is Beneficial," and "There Was No Big Bang." The author thoroughly considers the agenda, hidden or otherwise, of people proposing these ideas and notes established scientific findings that support or refute them. Originally published in hardcover 2001. ***Princeton U Pr, 2002, 244 p., b&w illus., paperback, $16.95.***



THE WORLD OF THE ANCIENT GREEKS

JOHN CAMP AND ELIZABETH FISHER

Tracing 3,500 years of ancient Greek culture from the Paleolithic era to the Ottoman Empire, this survey reveals the myriad ways in which these people made unparalleled contributions to the rise of Western civilization. This story is told as much by abundant maps, pictures of artifacts, and diagrams of dwellings as by the written word. Individual chapters examine gods and heroes, art and architecture, and the rise of Athens and the ways of its people. An overriding theme throughout the book is the struggle of the Greeks to interact peaceably with the Persians, Romans, and Minoans and their capacity to adapt through the centuries. Also evident is the Greeks' lasting impact on endeavors from modern politics to athletics. ***Thames Hudson, 2002, 224 p., color/b&w photos/illus., hardcover, $34.95.***

LETTERS

Evolution devolution

Perhaps much of the controversy about evolutionary psychology devolves from forgetting some basic biological definitions ("Evolutionary Upstarts," *SN: 9/21/02, p. 186*). The gene is the unit of inheritance, which has a complex and imprecise relationship with the mature, viable organism that has inherited it. The unit of evolution is the individual organism. Therefore, the arguments about what is more important in evolution are specious. Since "survival of the fittest" is actually an ecological phenomenon that occurred in the distant past under conditions that cannot now be duplicated, we will never prove which genes mattered most then for any given species.

DAVID P. VERNON, TUCSON, ARIZ.

Any system can evolve if it has some filter (environmental pressure) that selects some variants and not others, as well as some way of retaining the successful variants. As Charles Darwin's contemporary William Bateson showed, sometimes the system and its environment coevolve, as in the case of horses and grasslands. Sometimes, both/and is better than either/or.

ROGER M. KRAUSE, CHICAGO, ILL.

Meat of the issue

"Veggie Bites: Fossil suggests carnivorous dinosaurs begat vegetarian kin" (*SN: 9/21/02, p. 179*) is surely wrong in stating that the honey badger shuns meat. It aggressively attacks snakes and small mammals, as well as invades bees' nests for honey.

DEREK WALLENTINSEN, SAN PEDRO, CALIF.

I was looking at the picture of the animal's skull and wondering how large it is. There's no scale for reference, so I can't tell if it's the size of a *Tyrannosaurus rex* skull or a shrew skull.

RICHARD FRANTZ JR., CHESHIRE, CONN.

Scientists estimate the entire creature was about 1 meter long. —S. PERKINS

Put the ball in the hole

I would hope that the artist's conception of a black hole ("Hole in the Middle: Are midsize black holes the missing link?" *SN: 9/21/02. p. 180*) is not shared by many. The term *hole* was an unfortunate choice, since it conjures up an image of a tunnel rather than the actual sphere. In reality, the halo of light around the periphery of the black hole would cover the entire sphere from any direction of view.

ROBERT EDELBERG, PENNINGTON, N.J.