uncomfortable the situation will grow for researchers who have built instruments especially for it. One such device is a double-focusing three-axis spectrometer, designed by Peter Link of the University of Göttingen's Institute for Physical Chemistry. "You can't move it anywhere else without significant changes," he says. Petry and Zehetmair say they are not opposed to using MEU eventually—after the high-density fuel recipe is perfected and tested to ensure that the loss in neutron quality would be minimal. But even the next-generation MEU would require changes in the reactor's moderator tank, and using any less-enriched fuel would require boosting the core size and the reactor's power.

Both sides are hopeful that a deal can be worked out. "I still think we can get this reactor running within 6 months," says Zehetmair. Federal officials agree that it is feasible for the final operating permit to be issued before midyear—if the Bavarians compromise. Meanwhile, scientists are at the starting blocks, waiting for the gun. "Once the final permit is granted, the first fuel element could be installed in about 6 weeks," says Petry. "The fuel elements are ready and waiting in France."

–ROBERT KOENIG

CONSERVATION

No Easy Answers for Biodiversity in Africa

Wilderness areas, those vast regions untouched by humans, hold great allure. But in terms of conservation, focusing on only pristine, uninhabited spaces would leave many species vulnerable to extinction, according to a new analysis of human population and biodiversity in sub-Saharan Africa. On page 2616 of this issue, researchers report that some of the most densely populated regions on the subcontinent also contain the greatest biodiversity. "You can't do conservation and development in very different places," says Andrew Balmford, one of the study's authors. "If your goal is to preserve most of Africa's biodiversity, you're going to have to grapple with the challenges of preserving biodiversity where there are quite a lot of people."

The analysis does not surprise most conservationists, who for years have been talking about global "hot spots," areas rich in varied or rare species and also under exceptional pressure from human populations. But the current study provides a more detailed look, says ecologist Gustavo da Fonseca of Conservation International in Washington, D.C. "The fact that these hot spots are emerging even at this finer scale is really surprising," he says. "We were never sure if we could find hot spots within our global hot spots."

Balmford, a zoologist at the University of Cambridge, zoologist Carsten Rahbek of the University of Copenhagen, and their colleagues mined a comprehensive database at the Zoological Museum in Copenhagen describing vertebrate populations across sub-Saharan Africa. The team analyzed human census data and data on 1921 bird species, 940 mammal species, 406 snake species, and 618 amphibian species in geographical squares approximately 100 kilometers on a side.

Areas rich in species also tend to contain more people, the team found. To test whether the correlation might be explained by sampling bias—a possible tendency for species lists to be more comprehensive in easily accessible regions close to human population centers—the team compared the correlations separately for different animal groups. If a sampling bias was causing the correlation, says Sir Robert May, a zoologist at the University of Oxford, one would expect the effect to be stronger for less studied groups, for which data are sparse. But in fact, the correlation was stronger for better studied birds and mammals and weaker for relatively uncataloged amphibians.

The pattern is probably not unique to Africa, says Balmford. In North America, for example, "some of the highest conservation priorities have the highest real estate values," most notably along the East and West coasts. Smaller studies in South America show a similar pattern as well, says ecologist Stuart Pimm of Columbia University in New York City.

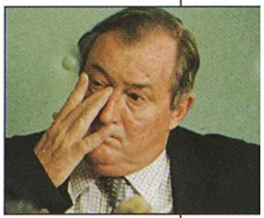
The team found no easy answers when it analyzed which 100-km squares would need some kind of protection to preserve nearly all known species in the database. A strategy that started in regions with minimal human populations still identified a set of squares

Crowded. Areas rich in biodiversity overlap with centers of human population, such as at Nairobi National Park in Kenya.

CREDITS: (TOP TO BOTTOM) SAYYID AZIM/AP; WILLIAM CONWAY/WILDLIFE CONSERVATION SOCIETY

ScienceScope

Leakey Ousted Kenya President Daniel arap Moi this week sacked prominent paleontologist and politician Richard Leakey (right) from his posts as head of the nation's civil service and an anticorruption team. Moi had appointed Leakey—a leader of the opposition and one of his staunchest critics—to the posts 20 months ago in a bid to stabilize his regime, which is under increasing pressure from foreign aid donors and in-country critics advocating greater democracy.



Leakey's tenure was marked by controversy over his management style and efforts to reform Kenya's bloated bureaucracy. His ouster, says a source close to the researcher, came as no surprise.

Westward Go! Germany's premier basic research organization, the Max Planck Society, is looking west again after a decade focused on building institutes in former East Germany. The society's governing board last week approved plans to build its 79th institute, for vascular biology, in cooperation with the University of Münster.

The new institute, which will focus on the molecular and developmental biology of the circulatory system, will be led by Belgian angiogenesis researcher Peter Carmeliet and German biochemist Dietmar Vestweber. Münster rector Jürgen Schmidt predicts the initiative "will give the university a big boost."

A Stretch Japan aims to dramatically boost public spending on science—if its economy recovers. This week the Cabinet was expected to endorse a plan to spend $195 billion over the next 5 years on R&D. If achieved, the outlay would raise government science spending to 1% of Japan's gross domestic product (GDP)—and put the nation near the top of global rankings based on the portion of GDP spent on R&D by private and public sources combined.

But reaching that goal rests on "a big assumption," says Hiroshi Tamada of the Council for Science and Technology Policy, a top advisory body. Japan's GDP would have to grow by 3.5% over the plan's span—a rate not seen since 1990.

Meanwhile, Japan's legislature last week approved nearly $27 billion in science spending for the 2001 budget that begins 1 April. The 0.5% increase falls below the amount needed to meet the new target. Officials are still looking for items that might boost the bottom line for science.

that contain an estimated 116 million people—almost a quarter of the population of sub-Saharan Africa.

The paper "cuts against much of the ethos of the conservation movement that wants to preserve absolutely pristine environments," May says. "I share that feeling, but there has to be much more work on determining minimal ecological structure: How much of the original habitat do you have to keep to enable particular plants and animals to coexist with humans?" Tom Lovejoy, a tropical biologist at the Smithsonian Institution and a consultant with the World Bank, says the work lends support to "mixed use" projects like the Mesoamerica biological corridor in Central America. The project aims to include strict protected areas as well as bird-friendly coffee plantations and regions in which a hydroelectric project will pay owners of the watershed as an incentive to preserve the forest.

But mixed-use strategies get mixed reviews. In some regions, Fonseca says, "the only way you're going to make sure anything is left is by having secure borders and protecting what you have." He says the study highlights the fact that if African biodiversity is to survive, "at some point we have to bite the bullet and make some very strong choices, even if those are costly and difficult both economically and socially," such as creating well-protected parks and compensating local residents.

The study should help guide some of those choices, Balmford says. Fonseca agrees. "We can't make these decisions unless we know where the species and people are," he says. "They've done that analysis in an extremely comprehensive way."

–GRETCHEN VOGEL

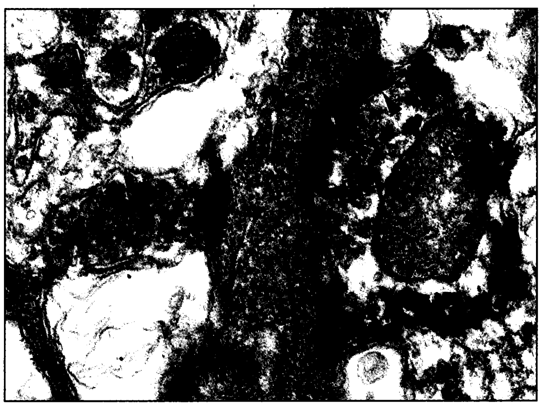
NEUROBIOLOGY

How Cannabinoids Work in the Brain

Marijuana may provide a euphoric high, but it can also boggle one's memory. The impairment is so pronounced in laboratory rats under its influence that they behave in some learning tasks as if a key memory area in their brains, the hippocampus, had been removed entirely. Now, the story takes an intriguing twist: Researchers have discovered that the "endogenous cannabinoids," marijuana-like chemicals made by our brain whose function has long been a mystery, play key roles in a process that may be central to the laying down of memory, among other things.

In reports this week in *Nature* and *Neuron*, three independent research teams—from the University of California, San Francisco (UCSF); Kanazawa University School of Medicine in Japan; and Harvard Medical School in Boston—have shown that cannabinoids are dispatched by some brain neurons to fine-tune the signals they receive. The cannabinoids accomplish this by turning down the activity of the neurons doing the signaling. One form of the process, known as depolarization-induced suppression of inhibition (DSI), occurs in the hippocampus, a brain area involved in memory, and in the cerebellum, which coordinates movements.

The discovery unites two previously unlinked research tracks. It offers "the first concrete example of physiological function" for the endogenous cannabinoids, says neuroscientist Leslie Iversen of the University of Oxford, U.K. And it finally reveals the identity of the molecule responsible for DSI; researchers had been searching for this so-called retrograde messenger for nearly 10 years.



Receptive. Antibodies to the cannabinoid receptor (black dots) are clustered in the membrane of an inhibitory neuron in a human hippocampus.

"This is extremely exciting," says neuroscientist Brad Alger of the University of Maryland Medical School in Baltimore, whose team discovered hippocampal DSI in the early 1990s. Now researchers can manipulate the cannabinoid messengers, he says, to "dissect out the roles of DSI in brain function and behavior." Alger believes it may prime individual neurons in the hippocampus for long-term potentiation (LTP), the synapse strengthening thought to be central to learning and memory. The discovery also has generated new insights into how marijuana intoxicates the brain.

None of the groups set out to solve the cannabinoid mystery. All were searching for the elusive signaling molecule in DSI. Two years ago, Rachel Wilson, a graduate student with Roger Nicoll at UCSF, took up the hunt. In slices of rat hippocampus, she showed that neurons produce the messenger in response to rising internal calcium levels and that, in contrast to most neurotransmitters, the messenger is not packaged in vesicles for release.

To Jeff Isaacson, a former student with Nicoll who was visiting the lab, those characteristics rang a bell: They're shared by the endogenous cannabinoids. On his suggestion, Wilson treated the brain slices with a chemical that blocks the function of cannabinoid receptors. It blocked DSI. "That experiment alone was the story," says Nicoll. Wilson confirmed with more experiments that a cannabinoid is the messenger, and she presented her work last November at the annual meeting of the Society for Neuroscience in Miami; her paper appears in this week's *Nature*.

During that same time, Takako Ohno-Shosaku, working with Masanobu Kano at Kanazawa University, was on a parallel course. Having taken her clue from a 1997 paper from Daniele Piomelli's team at UC Irvine, which showed that activated hippocampal neurons release endogenous cannabinoids, Ohno-Shosaku also found that a cannabinoid blocker prevents DSI in cultured hippocampal neurons. Her results are in this week's *Neuron*.

Neuroscientist Tamás Freund of the Hungarian Academy of Sciences in Budapest says his team had a clue that cannabinoids play a role in DSI: The researchers showed in 1999 that cannabinoid receptors in the hippocampus are located exclusively on the inhibitory neurons that receive the retrograde signal. "The amazing selective localization of the receptors made them an excellent candidate to mediate DSI," says Freund.

Meanwhile, Wade Regehr and graduate student Anatol Kreitzer at Harvard Medical School found that excitatory signals can also be inhibited, in a process similar to DSI that they called DSE. Working in slices of cerebellum, Kreitzer found that increased calcium levels trigger neurons to release the messenger that initiates DSE, but he was not able to identify it. After talking with Wilson at her poster presentation at the neuroscience meeting, he tried blocking cannabinoid signals. As he and Regehr report in this week's *Neuron*, this wiped out DSE, implicating cannabinoids in turning down excitatory as well as inhibitory inputs. The discovery that "excitatory synapses can do it, too," is important, says Stanford University neuroscientist Dan Madison, because "that makes it more widely useful" to the brain.

"I'd be really surprised," Madison adds, if DSI and DSE aren't found in other places in the brain. His hunch may soon be confirmed. Freund's group has found cannabinoid receptors in the amygdala, an area involved in emotional memory, on the same class of inhibitory neurons as those on which it is found in the hippocampus, so DSI may occur there. And last year, Yuri Zilberter of the Karolinska Institute, Sweden, reported a DSI-like phenomenon in the cerebral cortex of rats. Now,

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