protein might, for example, inhibit uptake into cells of the AIDS virus or prevent the cell migrations needed to build the new blood vessels required for tumor growth. "These are targets that [companies] have identified for a while, and they have been playing with them, but without any structural basis," says Arnaout.

Indeed, researchers say that the αVβ3 structure is sure to inject new energy into the integrin field. "In a lot of ways, it's really just a starting point," says cell biologist Jeffrey W. Smith of the Burnham Institute in La Jolla, California. But, he adds, "it changes the level of research that we can do."

–JENNIFER COUZIN

Jennifer Couzin is a writer in San Francisco.

ELECTRONICS

Organic Device Bids to Make Memory Cheaper

CHICAGO—Beware, silicon engineers: Organics are at the gate. Researchers have already turned electrically conducting organic compounds into light-emitting displays and flexible circuits (*Science*, 12 June 1998, p. 1691; 21 January 2000, p. 415). Now they're laying claim to one of silicon's remaining strongholds: memory. Last week, materials chemist Yang Yang of the University of California, Los Angeles (UCLA), told the American Chemical Society* that his group has devised an organic-based digital memory.

The new devices work similarly to flash memory, a relatively expensive silicon-based technology that retains its data even when power to a device is turned off. An organic version has the potential to be much cheaper because it could be far simpler to produce, says Edwin Chandross, an organic-electronics expert who runs a consulting firm in Murray Hill, New Jersey. "It's impressive," Chandross says of the new work. "A lot of people have been talking about trying to do this."

Talk hasn't gotten them very far. No one has yet found a way to make an organic device that has two stable states, which can encode the 0's and 1's of computer lingo.

Yang's group was struggling with this problem as well. The researchers first tried to make organic memory devices by putting a layer of conducting organic molecules between two electrodes and applying a voltage. That caused the conductivity of the organic material to rise, a signal that potentially could encode bits of information. But it dropped again when the voltage was turned off, so the chance to store information was lost.

On a hunch, one of Yang's postdocs, Liping Ma, suggested following the lead of compact-flash devices, in which tiny strips of metal act like batteries to store electronic charges. Yang gave him the green light, and Ma sandwiched a thin metal layer between layers of conducting organic molecules. To their surprise, it worked splendidly. The device could not only write and read bits of data but erase and rewrite them as well.

To write a bit of data, Yang's team simply applies a potential of 3 volts between a pair of electrodes bracketing the organic-metal-organic sandwich. The voltage makes the material between the electrodes more conductive, a quality it retains even when the voltage is turned off. That high-conductivity state acts as the 1. To read the bit, the UCLA team applies a second voltage of 1 volt. The highly conductive material produces a rush of electrons between the electrodes, signaling that the device is in the 1 state. Applying a third voltage of –0.5 volt returns the cell to its original low-conductivity state, a 0, which the team can read by applying another voltage of 1 volt.

New trick. Conducting organic materials similar to this light-emitting diode can store data.

Yang says his team has run through this write-read-erase cycle about 1 million times without seeing any signs of degradation. That track record leaves other researchers both impressed and scratching their heads, because just what causes the material in the device to change its conductivity when different voltages are applied remains a mystery. "It's intriguing," says Alan Heeger, a physicist at UC Santa Barbara, who won the Nobel Prize in chemistry last year for his work on conducting polymers. "I'd like to know what is going on."

In earlier devices that claimed similar properties, it turned out that metal from the electrodes was migrating into the organic layers and giving rise to some of the effect. Although such devices seemed to work for a short while, they were difficult to reproduce and eventually stopped working when the small metal fragments broke down, Yang says.

To test whether similar metal reactions were behind the properties of the new device, the UCLA team replaced its aluminum metal layer with layers of less reactive silver, copper, or gold. All worked similarly to the aluminum, Yang says. "It was the right experiment to run," Chandross notes; gold, in particular, is fairly inert and shouldn't react as aluminum does.

Whatever causes the change in conductivity, organic memory devices could move into applications quickly, Chandross and others say. Manufacturers can make the devices simply by evaporating different materials through a mask in a vacuum. UCLA has granted an exclusive license to a Boston-based start-up company interested in commercializing the technology. If the effort flies, it could result in ultracheap flash memory–based computers that turn on instantly, without the minutes-long boot-up that a standard computer needs to reload its working memory with data that get lost whenever the power goes off.

No doubt silicon is safe for a while. But it may soon be under siege.

–ROBERT F. SERVICE

* 222nd ACS Annual Meeting, 26–30 August.

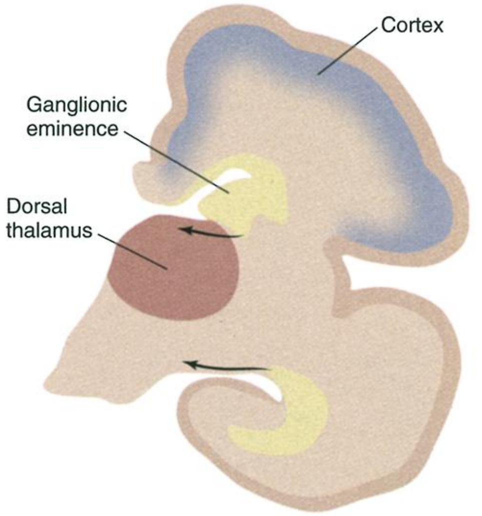
NEUROSCIENCE

New Route to Big Brains

Never mind the bipedal posture, relative lack of fur, or opposable thumbs. What really sets humans apart from other animals is our oversized brain. But building a bigger brain is an evolutionary challenge. In addition to all the extra neurons and other brain cells that have to develop, somehow all those cells have to be wired together correctly. Now, researchers report that in humans—but apparently not in other species—some neurons in the developing brain travel along an unexpected route. This detour allows them to link to and serve the most overgrown and recently evolved parts of the human brain—those involved in higher functions such as memory and problem solving.

"The exciting point here," comments developmental neurobiologist Gord Fishell of New York University, is that the study identifies a "fundamental difference in the way human brains develop." Neuroscientists still don't understand, he says, "what it is about the human brain that allows it to become more complex than [in other] primates." The newfound pathway, which is described in the September issue of *Nature*

CREDIT: YANG YANG/UCLA



Illegal immigration. Neurons in a forebrain from a 20-week-old human fetus travel from telencephalon structures (yellow) to the dorsal thalamus.

Neuroscience, might explain some of the differences, he says, as well as allow researchers to study which molecules are key to building a human brain.

Developmental neurobiologist Pasko Rakic of Yale University, who conducted the research with grad student Kresimir Letinic, calls the neurons' route an "illegal immigration." Normally, cells from the telencephalon, the part of the developing nervous system that grows into the most sophisticated parts of the brain—those that do the heavy lifting when it comes to problem solving, social interactions, and memory—don't mingle with cells from the diencephalon, which gives rise to less advanced structures such as the hypothalamus and optic nerves. No other neuroanatomists have ever reported that neurons can breach the theoretical wall between the two regions; when Letinic and Rakic looked at fetal monkey and mouse brains, they saw, as expected, no crossover from one region to the other. But when the team stained and studied slices from fetal human brains, obtained from aborted tissue that had been donated to a brain bank, they found a stream of cells migrating from the telencephalon to the diencephalon.

These wayward neurons land in the thalamus, a relay station that distributes information to the cerebral cortex. Although the diencephalon still builds most of the thalamus, the second wave of telencephalon cells specifically boosts the parts of the thalamus that feed into the frontal lobes and other cortical areas that are responsible for higher-level cognition. This includes passing along both sensory information and internally generated information, such as emotional responses processed in the hypothalamus. "The frontal cortex doesn't operate without interaction with [this part of] the thalamus," says neuroscientist Edward G. Jones of the University of California, Davis. The new report implies that "along with the expansion in cortex goes a new elaboration in the thalamus that helps promote [the cortex's] activity," Jones says.

To try to identify how the thalamus summons telencephalon cells, the researchers turned to fetal neurons in lab culture. They found that the human thalamus sends "come hither" signals that human telencephalon cells eagerly respond to, scooting toward the thalamus in a dish. Mouse telencephalon cells, in contrast, are repelled by the mouse thalamus. The Yale team hasn't yet identified the molecules that direct the neuronal migration. But if the researchers can decipher those molecular messages, the findings might help further explain how the human brain came to tip the interspecies scales.

–LAURA HELMUTH

CREDITS: (TOP TO BOTTOM) ILLUSTRATION: CARIN CAIN; SAM KITTNER

SCIENCE POLICY

Group Raises Hackles As Well as Funds

A Republican legislator has created the first political action committee (PAC) to support proresearch candidates for Congress. But some researchers and lobbyists are worried that the group's plan to back only Republicans could divide the community by forcing scientists to choose sides.

Representative Vern Ehlers (R–MI), a nuclear physicist who chairs the Science Committee's environment, technology, and standards subcommittee, heads the new group, called SciPAC. In a 10 August letter to potential donors, he complains that the U.S. scientific community "has not taken the steps necessary to support elected officials who have supported science." The stated goal of the committee is to "increase the influence of supporters of science, engineering, and technology in Washington."

But Ehlers makes clear that he's only talking about one side of the aisle. "As a Republican, I'm obviously not going to contribute to Democratic candidates," he told *Science*. Indeed, his letter takes an indirect swipe at the opposition, noting that "since Republicans took over Congress a mere 6 years ago, the federal investment in research and development has increased nearly $20 billion." Thomas Jones, SciPAC vice chair and public policy director for the American Association of Engineering Societies, puts it more bluntly: "Republicans are good for science."

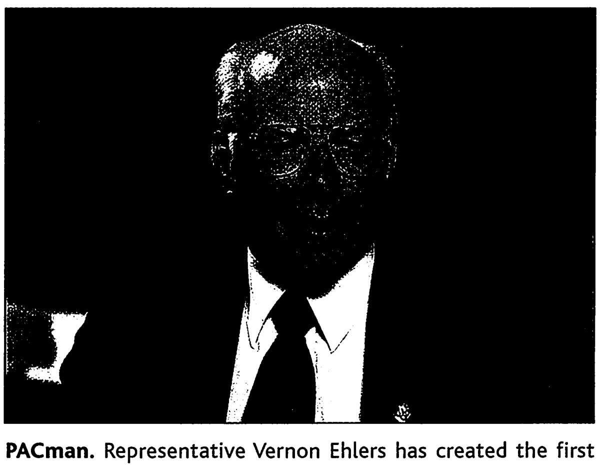
Science advocates have long complained that their community lacks the political muscle of other interest groups. And political action committees, which disburse funds to candidates, are a traditional way to win recognition and support. But the fact that Democrats need not apply for SciPAC funding troubles some old hands.

"The science community needs to be much more involved in the political process, and I have no problem with people raising money for candidates," says physicist Neal Lane, a former science adviser to U.S. President Bill Clinton and former head of the National Science Foundation (NSF). "But the science budget has bipartisan support, and no party can claim [full] credit." Lane warns that "making science into a partisan fight would not be good for science or for the community."

PACs created by politicians are typically designed to help just one party, says Jones, adding that Ehlers's role is to support the House Republican leadership. "And giving money to Democrats could jeopardize that leadership." More important than the question of partisanship, Jones argues, is the need to shore up support for science as the federal surplus disappears.

To succeed, however, Ehlers must convince scientists to write checks to a general fund that he controls. Direct contributions from researchers have helped elect some members, notably Representative Rush Holt (D–NJ), a physicist who has actively courted the scientific community. But a specific science-focused political action committee has never been tried.

Touted as "America's Voice for Science in Washington" on its Web site (www.scipaconline.org), SciPAC's financial goals are modest. "We're not going to raise a million dollars," Jones says. But he hopes



PACman. Representative Vernon Ehlers has created the first proresearch political action committee, for Republicans only.