created in 1954 by the founder of the Superior Oil Co., has long been a supporter of higher education and research. But last year its trustees decided to take advantage of a growing endowment, now $1.4 billion, to back the next superstars of biomedical research—a total of 25 over the next 5 years. "We wanted to identify the people who seem likely to become the really outstanding scientists over the next 20 to 30 years," explains William Butler, chancellor of Baylor College of Medicine in Houston, Texas, and chair of the scientific advisory board that helped to design the program and select the first batch of winners. "Keck deserves a lot of credit for coming up with such an exciting concept."

First class. Clockwise from top left: Clurman, Frydman, Ghosh, Gerstein, Hanson.

The four other winners are: Bruce Clurman, a cancer biologist at the Fred Hutchinson Cancer Research Center in Seattle; Judith Frydman, a biochemist at Stanford University working on protein folding; Partho Ghosh, a structural biologist at the University of California, San Diego; and Phyllis Hanson, a cell biologist at Washington University in St. Louis who studies protein and membrane dynamics in the neural system. All have taken up their first faculty position within the last 3 years, and all say that the money will allow them to scale up their research in a way that would otherwise be impossible.

The new program outdoes all other private efforts to support young faculty. The size of the awards beats the $625,000 over 5 years offered by the Packard Foundation and dwarfs the typical start-up grant from private and public bodies. Its closest competitor is a one-time awards program sponsored by the James S. McConnell Foundation, which earlier this year selected 10 Centennial Fellows to receive $1 million each as part of the 100th anniversary of its founder (*Science*, 29 January, p. 629). "We wanted to give them a chance to go forward full-bore, and our advisers said that a million dollars should buy them what they need," says Roxanne Ford, who heads Keck's medical program.

For Gerstein, the money means a chance to hire a crackerjack computer programmer and systems analyst to design and maintain a database to analyze the entire genomes of various pathogenic organisms. "I'm looking for someone who could command $150,000 in Silicon Valley," he says. "I can't pay that much, of course, but I want someone who can create a computational environment that my students and postdocs can take advantage of and not have to do it themselves."

The competition was by invitation only. Keck asked 30 top-ranked universities and medical institutions to submit one application from their single most promising young faculty member. From those, the foundation chose 10 finalists for face-to-face interviews. Next year Keck will make the same offer to another group of 30 institutions, with some holdovers, and after 5 years its board of trustees will evaluate the impact of the program and decide its fate.

—JEFFREY MERVIS

ELECTRONICS

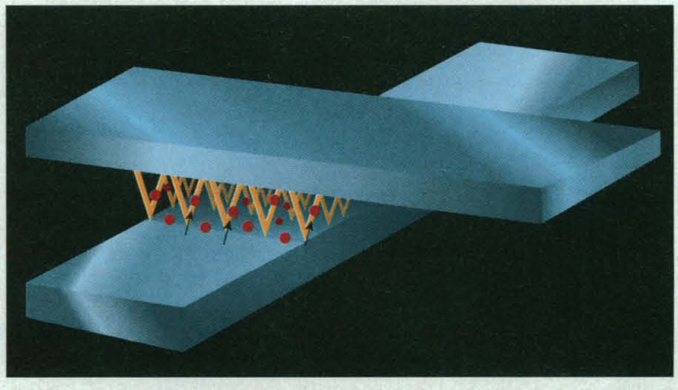
Organic Molecule Rewires Chip Design

Only one thing hasn't changed over the decades in the computer industry: the equation smaller equals faster. But as the transistors and other circuitry on computer chips continue to shrink, errors become easier to make. And a single broken wire or faulty transistor in the millions of devices on a chip will often render it useless. Now a team of California-based researchers is offering a revolutionary—and potentially cheap—way to sidestep the need for precision as circuit features get still smaller: a strategy for laying down millions of wires and switches without worrying too much about quality control, then electronically configuring the best connections, akin to the way the developing brain strengthens active neural connections while allowing inactive ones to wither away.

The key to the new design is its simplicity. Instead of spending billions of dollars on fabrication plants to ensure patterning perfection, the new approach would lay down its millions of wires and switches in a simple grid and then allow a computer to use those wires to configure the grid into proper circuits. At this point, the researchers, led by Jim Heath at the University of California, Los Angeles, and Stan Williams at the Hewlett-Packard Laboratories in Palo Alto, remain a long way from configuring millions of switches; the network that they describe on page 391 contains just four switches. And the five connecting wires are up to 11 micrometers wide, a hefty size compared to those in today's chips. Nevertheless, the novel approach "is pretty remarkable," says Dan Herr of the Semiconductor Research Corp., an industry-backed center in Research Triangle Park, North Carolina. "If something like this pans out, it would have a tremendous impact on the semiconductor market."

Chip designers worry that when the size of features on individual chip components drops below 100 nanometers—perhaps by the middle of the next decade—engineers will have little room for error: A wire misplaced by just a few tens of nanometers could cause a circuit to fail. And although patterning technology is improving, "we do not have the ability to make highly intricate patterns on that length scale," says Paul Alivisatos, a nanoscale patterning expert at the University of California, Berkeley. "But we can make simple patterns of that size."

So that is what Heath and his colleagues did. Instead of trying to precisely control the positioning of wires and switches, they opted to lay down a simple grid of devices, all electronically linked. Later, they figured, they



Simple switch. The electronic state of V-shaped organic molecules controls whether electrons can hop from the bottom to the top wire.

could activate certain paths within this electronic maze and shut down others, configuring the switches electronically to work together as a circuit. If particular switches in the grid were out of place or otherwise defective, the configuration would simply bypass them.

For their demonstration, the researchers used conventional chip patterning techniques to lay down a parallel set of four aluminum wires on top of a silicon chip coated with a layer of insulating silicon dioxide. Next, they coated the whole surface and wires with a layer, just one molecule thick, of organic molecules called rotaxanes. Finally, they channeled a vapor of titanium and aluminum through a mask carrying a thin slit oriented perpendicular to the other wires. As the vapor condensed, it formed the top wire that crossed each of the four others.

Each of these junctions—with a patch of rotaxane molecules sandwiched between the perpendicular wires—formed a switch. Unaltered, each switch was "on," allowing current to flow from the bottom wire, through the rotaxanes, and into the top wire. "[The rotaxanes] are like a stone in a river," says Heath. "It's hard for the electrons to make the entire leap across the river [from one wire to the other], but they can easily make half the leap and then jump again to the other side." But applying a small positive voltage between two perpendicular wires oxidizes the rotaxanes, permanently removing electrons and altering their electronic behavior to prevent current from flowing through them. "Now the only way electrons can get across is to jump over the entire river in one leap," says Heath. Because only a paltry few can manage it, the current drops precipitously and so the switch is "off."

This demonstration circuit is not very flexible, because the rotaxanes cannot be restored to their original state once oxidized, so turning off any given switch is irreversible. That's sufficient for read-only memory and certain kinds of logic circuits, as the California researchers showed when they linked several switches in circuits to perform basic logical operations. But the researchers are currently investigating similar organic molecules in hope of finding one that will switch back and forth. Such reversibility, says Heath, would allow them to create a novel version of computer memory that could be written and erased many times over.

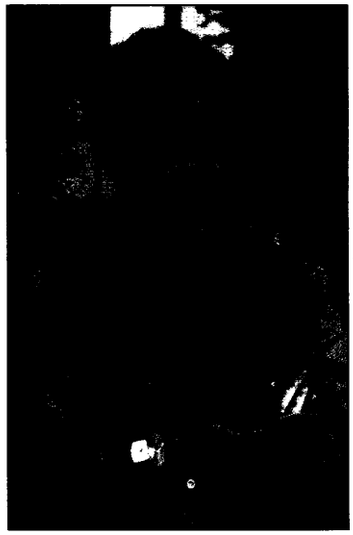
For now, says Heath, the novel circuitry has a long way to go before it's ready to challenge the Pentium. One project, he says, is shrinking the hefty wires. In theory, the switches should be unaffected as the wire dimensions fall, because the switching is performed by the rotaxanes, which would remain unchanged. In fact, Heath says that he and his colleagues are already working on a scheme to forge the wires out of carbon-based nanotubes, which can be just a single nanometer across yet micrometers long. If a computer based on nanotube wires and molecular switches could be built, says Heath, "you would get 100 workstations in a grain of sand." That would keep the computer industry humming along for quite a few years.

–ROBERT F. SERVICE

ELECTRONIC PUBLISHING

U.S., European Backers Differ on E-biomed Plan

U.S. and European groups hoping to start an Internet publishing outlet known as "E-biomed" appear to be on divergent paths, raising a question about whether they can agree on a format. Whereas the Americans want to begin the project with an unedited, unreviewed preprint depository, the principal European advocate—Frank Gannon, executive director of the European Molecular Biology Organization (EMBO) in Heidelberg, Germany—states in a position paper released on 7 July that he does not support such a scheme. In his paper, "EMBO and the electronic publishing initiative," Gannon says he welcomes electronic publication but draws the line at a "non-reviewed depository." "EMBO would have no role" in the latter, he writes.



Conditional mode. EMBO's Gannon favors e-prints if cleared by "assessors."

CREDIT: EMBO

Gannon is concerned that an unedited outlet could "severely undermine biomolecular research," and he thinks it "requires some element of monitoring." He believes that monitoring must "go beyond" culling out "injurious or insulting passages," as U.S. advocates have suggested. In Gannon's view, all articles with EMBO's stamp should be cleared at a minimum by a panel of "assessors," which he views as less demanding than full peer review. Gannon sees a need to distinguish between properly vetted reports and those that may be "incomplete" or "erroneous." His "simple" solution: create a streamlined process that checks to see that the experiments described are "correctly designed, the data are factually correct, and the conclusions are not exaggerated."

This approach differs from the original E-biomed concept. It was the brainchild of several U.S. biomedical researchers, including Stanford University geneticist Pat Brown, National Center for Biotechnology Information director David Lipman, and National Institutes of Health (NIH) director Harold Varmus. Varmus first mentioned that the federal government might get behind the proposal in comments to NIH's budget-writing overseers in the House in March (*Science*, 12 March, p. 1610). Since then, he has refined the idea in two commentaries published on NIH's Web page and in talks to scientific groups, including meetings of gene therapists, science writers, and Chinese researchers.

Although the details have changed, E-biomed's core format has remained the same. Brown and several colleagues in his field of genetics first envisioned it as a way to share large files of gene expression data rapidly without going through traditional peer review, editing, and paper printing. The basic idea was to support free access and immediate publication in an e-print depository, which would accept the work of any scientist, with screening to remove only obscene or gratuitous material. As the plan evolved, its advocates at NIH broadened the scope to include research across all the life sciences. They also added new layers, giving authors the option of submitting to an unreviewed section of the depository or to a section that would include multilayered review schemes, perhaps run by existing peer-reviewed journals. Publishers have mixed policies on whether they would accept e-print articles for print publication, but few have welcomed E-biomed.

Meanwhile, Varmus has suggested in recent talks that E-biomed be launched with what Lipman calls the "noncontroversial" element—the release of genetic data files, as originally proposed. This "would be a healthy place to start" the experiment "and see how we manage it," Varmus told a meeting of science writers in Washington, D.C., on 30 June.

Gannon, for his part, seeks to minimize differences with NIH. "I think that we are both still working toward the same general goal of a single searchable site," he wrote in response to an e-mail query: "We have different appreciations at present about how that can be achieved."

–ELIOT MARSHALL