**Science blog**

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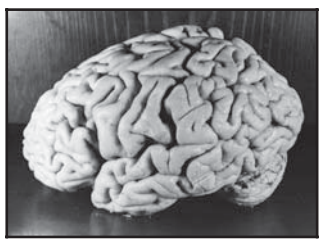
## SCIENCE BRIEFS

### Ants' composting helps invasive plant species

Researchers have found a problem with leaf-cutting ants' refuse piles. Leaf-cutting ants are the gardeners of the insect world, cultivating fungus on the leaf pieces they bring back to the nest. After they harvest and feed the fungus to the colony, leaf-cutters often discard the organic debris in piles. Researchers in Argentina report that leaf-cutter refuse piles can contribute to the spread of invasive plant species. Alejandro G. Farji-Brener and Luciana Ghermandi of the National University of Comahue studied the abundance and growth of two nonnative thistle species along roads in a national park in northern Patagonia. They found that refuse piles had up to nine times more nutrients than normal soil farther from ant nests. Those nutrients enabled the thistles to thrive: Plants were up to six times as abundant on refuse piles as elsewhere, seedlings were far hardier, and adult plants produced up to three times as many seeds. The findings were reported in *The Proceedings of the Royal Society B: Biological Sciences*.



### Brain's changes could cause 'mindless errors'

A new study sheds light on "mindless mistakes." Tom Eichele of the University of Bergen in Norway and collaborators including Vince D. Calhoun of the Mind Research Network in Albuquerque used functional magnetic resonance imaging to look at what goes on in the brain before an error. Participants played a simple game that involved responding to arrows on a computer screen while the fMRI machine measured blood flow and oxygenation in parts of the brain. As Eichele and his colleagues report in *The Proceedings of the National Academy of Sciences*, no single "blip" or event signals an error. Rather, brain patterns start to change about 30 seconds before an error is committed. The changes were seen in two brain networks. One, called the default-mode region, is normally active when a person is relaxed and at rest. When a person is doing something, like playing the game, this region becomes deactivated. But the researchers found that in the time leading up to an error, the region became active again: The subject was heading toward a relaxed state. Another network in the right frontal lobe gradually became less active; this is an area thought to be related to cognitive control, Eichele said, to keeping "on task." He said it might be possible someday to develop a warning.

### Mercury long in river spreads to land birds

Mercury contamination can be a big problem in rivers, as it moves up the food chain, accumulating in top predators. What goes into the river largely was thought to stay in the river, or in creatures that feed in it: aquatic insects, fish and fish-eating birds. In the South River in Virginia, however, the mercury has moved from the river to the shore, according to a study by Daniel A. Cristol and colleagues at the College of William and Mary. They report in *Science* that some nonaquatic bird species that do not feed on fish but that breed within 50 yards of the river have high mercury levels in their blood. The river was heavily contaminated with mercury sulfate from 1930 to 1950. Most of the 13 terrestrial birds tested had levels similar to or higher than the aquatic birds. The main culprit is spiders, which can be 30 percent of birds' diets and have high levels of mercury.

**— From wire reports**

## HOW TO REACH US

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# Super fast Super big Supercomputer

FRED SQUILLANTE | DISPATCH

**The Ohio Supercomputer Center has about 2,000 users that include universities, hospitals, businesses and the military. Jim Giuliani, left, is client and technology support manager; Kevin Wohlever is director of supercomputing operations.**

## Researchers line up to use Ohio's setup, which can perform 21.9 trillion computations per second

**By Kevin Mayhood**
THE COLUMBUS DISPATCH

Sitting at old wood desks topped with computer keyboards and flat screens, Christopher Hadad's team of computational chemists bang out program codes in their lab at Ohio State University.

They are trying to design a customized enzyme that, if injected into the body, would protect the military, first responders and others from fatal nerve agents.

At the University of Toledo, physics professor Jacques Amar's team of researchers simulates how films that could be used in semiconductors, computer chips and solar panels can be grown in layers as thin as a molecule.

And at the University of Cincinnati, physics professor Mark Jarrell leads a team trying to understand and predict how complex materials, made up of three or more elements, behave.

They are all plugged into the Ohio Supercomputer Center, where the latest incarnation of a computer can do in one day what a top-model desktop computer would take several years to accomplish.

"I need the firepower," said Hadad, who is working on six federally funded projects that depend on the center housed at Ohio State and others like it across the country.

See **SUPER** Page **B7**

TOM DODGE | DISPATCH

**Toby Sanan, left, an Ohio State University graduate student, and OSU chemistry professor Christopher Hadad display a complex enzyme they modeled using the supercomputer.**

### Supercomputer by the numbers:

**6**
The number of supercomputers at the center

**5,100**
Processors in those supercomputers

**2,000**
Registered users (100 to 300 at a time)

**13,811,270.3**
Hours that processors ran in 2007

**400**
Memory in terabytes, enough to store 90,000 full-length movies

**3,864**
Processors in the largest of the supercomputers, the IBM 1350 Cluster

**21.9 trillion**
Calculations the IBM can make per second

**20,000**
The processing equivalent in standard desktop computers

**90**
Tons of cooling power needed

Source: Ohio Supercomputer Center

ANDREA KJERRUMGAARD | DISPATCH

## SUPER

FROM PAGE B6

In the most recent ranking in November, the Ohio Supercomputer Center was named the 76th-fastest computer worldwide and the ninth-fastest among academic centers.

Since then, Ohio has increased the center's speed by about 5 percent, said Kevin Wohlever, director of supercomputing operations.

This supercomputer center, which turns 21 this year, is starting to hum.

The Ohio Supercomputer Center has about 2,000 users that include universities, state agencies, hospitals, private businesses, the military and the National Institutes of Health.

Researchers have access to six computer systems, and 100 to 300 users can run programs at a time.

They are connected, along with K-12 schools, public broadcasters and federal labs, by more than 1,800 miles of high-speed fiber-optic cable.

"I'm typically using several hundred processors," Amar said. "For the biggest projects, the calculations take months."

By subject, top users are studying physics, chemistry, materials research, molecular bioscience and a variety of engineering disciplines.

Most are using computational science, which simulates all kinds of phenomena, as different as the interaction between two molecules and the influence of greenhouse gases on the global climate.

"There are so many high-quality people here doing really nice work," said Jarrell, who chose to work in Ohio because of access to the center and the support provided by its more than 100 employees.

• • •

Ohio created the center in 1987 after the National Science Foundation rejected Ohio State's bid to become home to a federal supercomputing center. Universities in Illinois, San Diego and Pittsburgh won the grants.

Ohio rented computers at first, and in 1989 plunked down $20 million (Ohio State asked for $40 million) to buy the Cray Y-MP 8D, the largest and fastest supercomputer in the world.

The system was capable of performing 2.6 billion calculations per second and had about 40 gigabytes of memory, or about half of what a $250 iPod can store.

Today, the center's largest computer, an IBM 1350 Cluster, cost $4.5 million and is more than 10,000 times faster than the original Cray. The Cluster also has 210 times more memory.

The 1350 is made up of nearly 4,000 processors that use chips that are three times faster than those in an average desktop PC. The processors are linked so closely that they can act as a, well, supercomputer.

To create a top-10 supercomputer, the center estimates it would need $200 million or more, said Executive Director Stanley Ahalt. Power and cooling costs alone would run as high as $5 million annually.

OHIO SUPERCOMPUTER CENTER

**Above: Dr. Gregory Wiet, a pediatric ear, nose and throat surgeon, is the co-creator of a surgical simulator that relies on the Ohio Supercomputer. It helps teach medical students about drilling into the skull.**

**Left: Ohio State bought the Cray Y-MP 8D supercomputer for $20 million in 1989.**

Ohio invests millions of dollars every two years to buy newer, faster equipment, Ahalt said. The most current funding includes $6.8 million for supercomputing and $8.5 million for maintaining the network. Researchers say they are happy with the IBM cluster and its capabilities, including performing 21.9 trillion calculations per second.

"It's a machine with a Midwest attitude," Wohlever said.

• • •

The BlueGene/L, developed by IBM and Lawrence Livermore National Laboratory, is the world's fastest supercomputer. It has held the crown since November 2004.

Last year, the computer system, operated by the University of California, was beefed up to perform 578.2 trillion calculations per second (in computerese, it's called 578.2 teraflops).

The largest cluster computers can handle highly complex calculations that would leave smaller computers breathless. For example, the U.S. Department of Energy uses supercomputers at Livermore to simulate the effects of aging and storage on the country's nuclear-weapons stockpile.

The four next-fastest computers are housed at the Forschungszentrum Juelich research center in Germany, the New Mexico Computer Applications Center, Computational Research Laboratories in Pune, India, and a Swedish government agency.

The speeds at those centers range from 102.8 teraflops to 167.3 teraflops.

The National Center for Supercomputing Applications, at the University of Illinois at Urbana-Champaign, is set to become the biggest of the big in 2011 when it installs a $218 million IBM setup. The system, called Blue Water, will reportedly perform 1 quadrillion calculations per second. The National Science Foundation is footing the bill.

The federal government began to boost its supercomputer spending when Japan's Earth Simulator became the world's fastest system in the world in 2002. At the time, the Japanese computer was five times faster than the best the United States had to offer.

• • •

Gregory Wiet, a pediatric ear, nose and throat surgeon at Nationwide Children's Hospital, developed a surgical simulator that relies on the Ohio Supercomputer.

The simulator, created with the center's Don Stredney, lets medical students feel as if they are drilling into the temporal bone in the side of a skull while "seeing" the results.

Stredney also helped develop simulators for veterinary students learning simple procedures including skin-punch biopsies, said OSU professor Mary McLoughlin.

These kinds of simulated surgeries reduce the number of live animals the veterinary school has to use.

In Chillicothe, doctors at Adena Health Care Systems use the network to consult "face to face" with specialists at Children's Hospital who examine newborns via digital cameras and look at X-rays and MRIs to help them decide whether more-intensive care is needed in Columbus.

"The visual clarity is wonderful; they can see a rash and determine what to do," said Susan Rowe, service-line director of Women and Children Services at Adena.

Online consultations helped reduce transfers from Chillicothe to Columbus from 70 to 35 last year, Adena said.

Other examples of supercomputing capabilities include Procter & Gamble analyzing the aerodynamics of potato chips because its Pringles chips flew all over the place when packaged at high speed. All it took was a slight shape change.

The Ohio center estimates it draws in $8.75 in research money for each $1 it spends. Much of the return is in the form of grant money that researchers receive to do their work; not all of it comes to the center.

"A modest investment in high-performance computing does not produce a top-10-in-the-world machine," Ahalt said. "But a modest investment does yield incredible results in terms of the research done."

*For more information about the center, go to http://www.osc.edu/.*

**kmayhood@dispatch.com**

### Supercomputer super-users

Ohio Supercomputer Center users are ranked by multiplying the number of computer processors they use for their work and the hours they are used. These are called CPU hours. Using supercomputers that have hundreds or thousands of processors racks up hours quickly. The top 10 users by CPU hours in 2007:

**1. (1,810,255 hours) John W. Wilkins, Ohio State University, physics.** Investigating the thermodynamic and structural properties of titanium alloys in aerospace research.

**2. (1,094,659) Christopher Hadad, Ohio State, chemistry**. Involved in six projects, including developing bioscavengers to counteract nerve agents.

**3. (614,281) Jenping Chen, Ohio State, aeronautical engineering.** Simulating airflow through jet engines and other turbomachinery.

**4. (577,771) Ju Li, Ohio State, materials science and engineering.** Simulating material design for jet engines, fuel cells and advanced energy storage.

**5. (496,663) Jacques Amar, University of Toledo, physics and astronomy.** Investigating the processes behind thin-film growth that can be used in making semiconductors and solid-state lasers.

**6. (419,421) Somnath Ghosh, Ohio State, mechanical engineering.** Simulating thin-film polymer composites to develop a computational design tool that captures the dimension-dependent properties of polymer nanostructures.

**7. (363,642) Wolfgang Windl, Ohio State, materials science and engineering.** Simulating structure of carbyne, a rare form of carbon that typically exists only at extremely high temperatures.

**8. (302,168) Chenglong Li, Ohio State, medicinal chemistry.** Several studies, including investigating a class of receptors influenced by nicotine addiction and involved in Parkinson's and Alzheimer's diseases.

**9. (298,980) Michael E. Paulaitis, Ohio State, chemical engineering.** Several projects, including investigations into diverse T-cell populations and the molecular thermodynamics of protein separations.

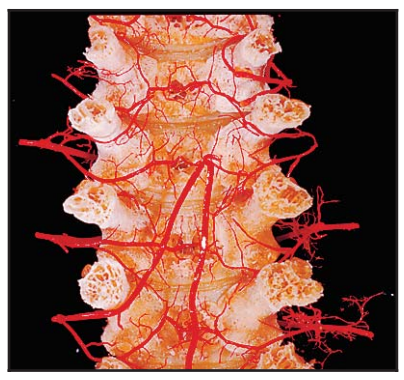
**10. (224,328) Valentin Gogonea, Cleveland State University, chemistry.** Investigating nitric oxide/nitric oxide synthesis enzymes.

Source: Ohio Supercomputer Center

'STEREOSCOPIC ATLAS'

# View-Master's 3-D slides of anatomy going online

**By John Schwartz**
THE NEW YORK TIMES



WILLIAM B. GRUBER VIA THE NEW YORK TIMES

**Blood vessels cluster in a cobwebby tangle along a spinal column.**

For more than 17 years, Dr. David L. Bassett was engaged in creating what has been called the most painstaking and detailed set of images of the human body, inside and out, ever produced. In 3-D.

Bassett was an expert in anatomy and dissection at the University of Washington and worked closely with William Gruber, the inventor of the View-Master, the three-dimensional viewing system that GAF Corp. popularized as a toy in the 1960s. Together, they created the 25-volume *Stereoscopic Atlas of Human Anatomy* in 1962.

It included about 1,500 pairs of Kodachrome slides, along with line drawings that made the details more discernible.

The paired slides could be examined with a View-Master, making the chest cavity look cavernous, and making details of structure and tissue stand out unforgettably.

The atlas was an immediate success, and the images became an important resource for medical students. But the atlas went out of publication later in the decade.

Thanks to Stanford University's school of medicine, however, the work soon will be available to the world. The school is bringing the images online. For a sampling, go to flickr.com/photos/stanford-medicine/sets/72157603949930348.

STARGAZING

# Galaxies' intricacy leads to natural appreciation

While walking the trail at Highbanks Metro Park the other day, I ran into an avid bird-watcher.

He commented that he didn't like stargazing because he didn't want to interpose his "experience of nature" with anything as "high-tech" and "artificial" as a telescope.

"You can do a whole lot of stargazing with those $200 birdin' binoculars around your neck," I replied.

TOM BURNS

Granted, the connection between the sky's flickering specks of light and nature is difficult to see at first glance.

Our ancient forebears had no trouble with the concept, of course, and put their gods in the sky, from which they controlled the natural forces below.

Consider, for example, the constellation Virgo, the virgin, which looks a bit like a wine glass with a deep bowl of stars at the top and a thin stem of stars below. Virgo rises in the early evening during spring and is up all night. It spends the cold months below the horizon and the warmer months above it.

Accordingly, the ancient Greeks blamed the constellation for the cold of winter and praised it for the warmth of summer. Its connection with nature also is present in a modern, scientific way.

Nestled in the bowl of Virgo is a considerable accumulation of fuzzy patches — hundreds in a telescope and a few that are even accessible by decent binoculars in dark, rural skies.

This Coma-Virgo Galactic Supercluster consists of thousands of galaxies like our own Milky Way. We are separated from its center by a mind-numbing 60 million light-years.

Its galaxies are considered clumped together by universal standards, but they are still separated from each other by millions of light-years. This is the true texture of the natural world on its largest scale.

Quite naturally, we tiny humans recoil from such vastness and emptiness. The structure of a leaf seems far more beautiful and far less daunting. But consider this, fellow naturalists: A galaxy consists of all its parts, large and small.

The Milky Way is mostly composed of 300 billion stars. However, our galaxy also is made up of our wondrous planet, every leaf on every tree, and you.

In fact, the Milky Way is one of the galaxies on Coma-Virgo's outer edge. When you go out and gaze at it, you become the part of the Coma-Virgo Supercluster that is looking at itself.

How's that for re-establishing your relationship with nature?

*Tom Burns directs Ohio Wesleyan University's Perkins Observatory in Delaware.*

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ARCHAEOLOGY

# Monuments helped link ancient man to heavens

Stonehenge, one of the most famous ancient monuments in the world, is widely thought to have served as a kind of astronomical observatory.

It is claimed that someone standing at the center of the concentric circles of stones would, on the morning of the summer solstice, see the sun rise over the distant "Heel Stone."

BRADLEY T. LEPPER

Thousands of people visit the site every year to watch this cosmic convergence.

Unfortunately, says Lionel Sims, an anthropologist at the University of East London, the sun actually doesn't rise over the Heel Stone on the summer solstice. It's off by 1.5 degrees.

This does not mean there is no cosmic connection to Stonehenge. Sims believes we've been looking at the site from the wrong perspective.

He reports in the June 2006 issue of the *Cambridge Archaeological Journal* that Neolithic visitors, standing at the Heel Stone and looking back toward the offsetting rings of giant stones, would have seen an apparently solid wall with two "windows."

Once every 19 years, on the winter solstice, the sun and the dark moon would appear in these windows as they set "at the start of the longest and darkest night of the year."

A similar interweaving of the lunar and solar rhythms also can be found at some ancient Ohio sites. High Bank Works, a giant earthwork located south of Chillicothe, con sists of a circular enclosure connected to an octagon.

It is aligned to the 18.6-year-long cycle of moonrise and set as well as to sunrise and set on the summer and winter solstices.

It is remarkable that people on both sides of the globe used monuments' architecture in similar ways to express their relationship to the cosmos.

Sims is speaking tomorrow evening at the Hopewell Culture National Historical Park in Chillicothe and on Saturday at the Newark Earthworks Day celebration at Ohio State University's Newark campus.

*For details about Newark Earthworks Day, go to www.octagon-moonrise.org.*

*Bradley T. Lepper is curator of archaeology at the Ohio Historical Society.*

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