mit it to their offspring.

Experts in the field of transgenic animals welcome the new study for adding yet another gimmick to their arsenal of techniques. "It's always nice to have a large collection," Robl says. And the longer the list, he adds, the easier it might become to make transgenics in other species. "This study will create a stir of activity," Seidel says. "I'm sure a lot of people will be trying it."

Whether the expected activity will pay off is, however, a matter of debate. "It will probably not supersede anything that is out there because the efficiency is not that much better than [DNA] microinjection," says Wall. (Current DNA microinjection has a success rate of about 10% in mice.) But Perry says that comparing his new technique to the much more advanced DNA microinjection is unfair. He notes that the efficiency of the latter has increased by three- to fourfold since the first experiments. "If we have a similar increase, almost every animal will be transgenic," Perry concludes.

But the skeptics contend that even if that can be accomplished for mice, using ICSI to transfer genes into other species still might not work. "ICSI is technically quite challenging; it's not as simple as DNA microinjection," says Wall. Perry disagrees, saying that it can't be that hard because "three of the four people who performed the injections had never made a transgenic animal in their lives. It'll take a little time [to perfect the technique]; we're only at the start."

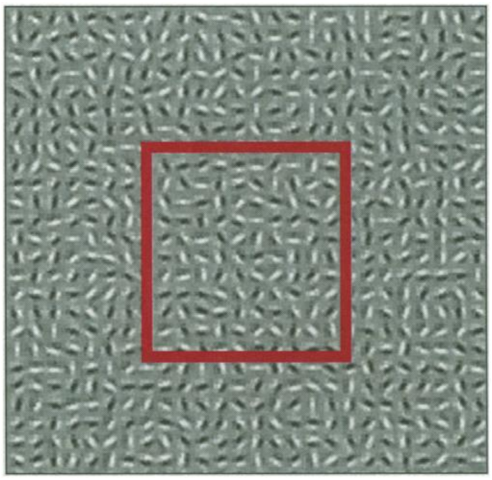
And he should have help in the effort. Despite his reservations, Wall recently purchased one of the $10,000 piezodevices to see for himself whether ICSI lives up to the claims. —MICHAEL HAGMANN

NEUROBIOLOGY

Time Cues Help the Brain See Objects

One of the most critical jobs our visual system performs is to group the myriad features of a visual scene into the discrete objects that form the scene. As New York University neuroscientist Anthony Movshon explains, "It is very hard to analyze an image until you have broken it into the objects it contains." Fortunately our brains are virtuosos at this task, called binding, linking even the disjointed parts of an object that is heavily obscured, such as a figure seen through dense woods. Work described in this issue reveals one of the brain's tricks for sorting through scenes so efficiently.

Using psychophysics experiments, in which human volunteers solve visual puzzles, neurobiologists had already shown that cues such as color, continuity, texture, and movement help the brain assemble objects from their parts. On page 1165, Randolph Blake and graduate student Sang-Hun Lee of Vanderbilt University in Nashville, Tennessee, provide the most convincing demonstration yet that the visual system can also exploit timing information, even in the absence of any other cues, grouping features of the scene that change at the same time into coherent objects.



Hidden shapes. No shape emerges from a static image of random circular patches; only when the patch is put in motion does the timing of motion changes reveal the outlined rectangle. For a demonstration, visit www.psy.vanderbilt.edu/faculty/blake/Demos/TS/TS.html

CREDIT: SANG-HUN LEE & RANDOLPH BLAKE

This is "perhaps the most interesting new work in visual psychophysics to come out in the past 10 years," says neuroscientist William Newsome of Stanford University School of Medicine. "It gives us even more appreciation than we had before for the clever approaches that biological visual systems take to make sense of the visual world." In addition, the work has spurred a vigorous debate among neuroscientists about whether it provides support for a controversial hypothesis postulating that neurons in the visual system that are responding to different parts of the same object become bound together by firing in synchrony.

For their experiments, Blake and Lee tested people's ability to see shapes in abstract patterns of small circular patches on a computer screen. As anyone knows who has watched a well-drilled marching band spell out the school's letters by having some members march in a different direction than the rest, a common direction of motion can make shapes jump out of such a pattern. But Blake and Lee wanted to test whether the brain could see a shape based not on common motion, but simply on common timing of visual changes. Several recent studies had suggested that the brain could use timing information for binding, but Blake notes that those tests—based on flickering patterns of dots—contained other cues as well. He and Lee wanted a test in which timing was the only cue to the form hidden in the scene.

To do this they used an array of patches that resembles a completely chaotic marching band, whose members move about the field in a random way. In a rectangular region at the center of the field, however, all of the patches repeatedly changed their direction of movement simultaneously, at irregular intervals. People viewing the test could see the rectangle well enough to tell whether it was oriented vertically or horizontally.

"They have very carefully removed all the spatial information," says Movshon, and "demonstrated that … you can drive a binding process purely with temporal stimuli." It is reasonable that timing would be a binding cue, says Movshon, because when a real object moves, all its parts generally begin to move at the same time. What's more, in some natural situations, timing alone, rather than a shared direction of motion, might be the main cue. "Imagine a disturbance in a forest, created by a predator moving around in a tree," he says. A synchronous change in the movement of leaves on that branch may be the only clue to the predator's presence.

Lee and Blake's experiment doesn't identify the brain neurons responsible for seeing the rectangle, but Newsome notes that movement-sensitive neurons reacting to the synchronous change in motion are likely to fire synchronously. And that notion sounds familiar, says Stanford neuroscientist David Heeger. It "makes you think immediately," he says, about the hypothesis advanced by neuroscientist Wolf Singer of the Max Planck Institute for Brain Research in Frankfurt, Germany, and others, that synchronous firing binds together neurons perceiving the same object (*Science*, 24 August 1990, p. 856).

Heeger notes, however, that the subjects in Blake and Lee's experiments are responding to synchronous timing in the visual image itself. Singer, on the other hand, holds that neurons responding to different parts of an object will synchronize even if there is no timing signal coming from the object. "I don't think [this new experiment] bears at all on the question of whether the brain uses temporal synchrony to signal binding for other kinds of patterns," says Movshon, and Newsome, Heeger, and others adamantly agree.

But Singer does not. He is elated, he says, to see "direct evidence that synchrony is interpreted by the cortex as a signature of relatedness when it is induced externally. It would be strange," he adds, "if internally generated synchrony … were interpreted in a different way."

While that debate rages on, researchers are jumping on other avenues opened by the Vanderbilt team's findings. They "tell us something new and important about what the visual system can do," says Newsome. And that, adds Heeger, "opens up the opportunity for trying to measure and understand the underlying neural basis. Immediately you think, 'What is it that the neurons are doing; what is the neural code for this?' " A number of labs, he says, are sure to design experiments to search for that neural code.

–MARCIA BARINAGA

PLANETARY SCIENCE

Asteroids Form Rocky Relationships

A run-in with a huge asteroid is bad enough, as movies like *Deep Impact* have made all too graphic. Now there's a scenario for the next round of threat-to-humanity movies: double impacts. Sightings of asteroids with companions—the latest of them just reported on the Web—are convincing astronomers that such pairs are far from rare.

Indirect evidence, such as paired impact craters on Earth, had already hinted that asteroids sometimes come in pairs. In the late 1970s, some astronomers watching stars blink out as asteroids passed in front of them

Double trouble. A pair of asteroids traveling together created Clearwater West (36 kilometers in diameter) and East craters in northern Quebec 290 million years ago.

reported extra flickerings that might have been caused by companions—although colleagues remained skeptical (*Science*, 17 July 1987, p. 250). The first direct proof that asteroids can have moons of their own came when the Galileo spacecraft flew by 56-kilometer Ida in 1993 and photographed tiny Dactyl, a 1.5-kilometer body orbiting about 100 kilometers away. And now astronomers observing from the ground have detected a much heftier companion around the 214-kilometer asteroid Eugenia.

In a meeting abstract newly posted to the Web (scorpio.tn.cornell.edu/ACM/web_abs.html), astronomer William Merline of Southwest Research Institute in Boulder, Colorado, and his colleagues report that they spotted a 15-kilometer satellite orbiting about 1200 kilometers from Eugenia. Eugenia and its satellite are a single fuzzy spot of light in an ordinary telescope, but late last year, in the course of a 200-asteroid search for satellites, Merline's group was able to separate them with the 3.6-meter Canada-France-Hawaii Telescope (CFHT) on Mauna Kea, Hawaii. The CFHT was equipped with an adaptive optics system that precisely undoes the blurring effects of atmospheric distortion (*Science*, 27 June 1997, p. 1994).

More candidates for binary asteroids are emerging from observations of the pulsating brightness of asteroids that pass near Earth. Most asteroids reflect varying amounts of sunlight as they rotate because of their irregular shapes, but a half-dozen so-called near-Earth asteroids (NEAs) observed by Petr Pravec of Ondrejov Observatory near Prague and his colleagues and by Stefano Mottola of the DLR in Berlin flicker as if one body is periodically passing in front of or behind another perhaps twice its size. Although the Eugenia observations are "pretty hard evidence" for a satellite, says astronomer Alan Harris of the Jet Propulsion Laboratory in Pasadena, California, the light variations of at least a couple of the NEAs are "highly suggestive."

As satellites of asteroids have proliferated, theoreticians have been trying to explain how they formed. After Dactyl was spotted near Ida, some suggested that the pair came together after a collision shattered a precursor body into a swarm of smaller asteroids, and a larger fragment managed to capture a smaller one gravitationally. But no one has tested this idea with detailed calculations. Noting that smaller collisions may have turned many other asteroids into rubble piles, William Bottke of Cornell University and Jay Melosh of the University of Arizona, Tucson, suggested another scenario in 1996: Earth's gravity, they said, could split a rubble-pile asteroid in two if it passed nearby.

Eugenia's satellite is more perplexing, says Melosh. Although Merline calculates

CREDIT: (TOP) NASA/JPL/CALTECH; (BOTTOM) NASA

ScienceScope

Rocket Science Troubled by a string of commercial and military launch failures, NASA is reexamining its own unmanned rocket program. Over the last 9 months, the Defense Department and communications companies have lost billions of dollars worth of satellites to flawed lift-offs, including three in one recent 8-day span. Although NASA has a mostly unblemished record with its single-use rockets, space agency officials last week delayed the launch of a weather satellite and ordered a review of dozens more scheduled unmanned science flights.

The review "is an extra precaution," says a NASA engineer. "We'd like to stay out of the headlines." He doesn't expect the extra look—which could be finished by next month—to cause delays for scientists with space-bound projects.

Digging In After nearly 30 years of skirmishes among developers, archaeologists, and government officials, France has taken a big step toward regulating "rescue archaeology." Culture minister Catherine Trautman last week unveiled a plan to end what she calls the "quasi-permanent crisis" by creating a new agency to oversee the excavation of ancient remains threatened by development projects.

Last year, archaeologists went on strike to derail a plan to open such projects to competitive bidding, saying it would damage research (*Science*, 16 October 1998, p. 407). But now, scientists are mostly welcoming a proposal to replace a semiprivate archaeological contracting agency with a public entity under the culture and research ministries. Plans to involve government and academic researchers in projects are an "affirmation that rescue archaeology is a scientific activity and a public service," says Françoise Audouze of the Center for Archaeological Research in Nanterre.

But one archaeologists' union is unhappy with a complicated formula that will exempt small developers from paying for digs. It is calling for changes before the government presents the plan to Parliament this fall.

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