being defoliated en masse by invading woolly adelgids, exotic parasitic insects. The chain reaction continues. The endangered spruce-fir moss spider, a small tarantula that needs shade from the trees, is now found at just a few known sites, according to entomologists.

This is just one signal that the problem is not limited to the Northeast. Arthur Bulger, a fish ecologist at the University of Virginia in Charlottesville and also a co-author, says that acid rain effects are now becoming more apparent in the Southeast, some 20 years after they appeared in the Northeast. He and colleagues have chronicled these effects in a paper in the *Canadian Journal of Fisheries and Aquatic Sciences* last year and another in press at *Hydrology and Earth System Sciences*. The reason for the time delay, says Bulger, is that southern soils are generally thicker than northern ones and thus able to sponge up far more acid before leaking it to the surrounding environment. But now that soils are saturated, acid levels in nearby waters are skyrocketing. Bulger's colleagues have studied 50,000 kilometers of streams; in a third, he says, fish are declining or are already gone. He predicts another 8000 kilometers will be affected in coming decades.

Until recently, acid rain has been largely off the radar screen in the western states, in part because the population is smaller and the coal that fuels power plants there is much lower in sulfur. But now the region's cattle feedlots are booming, as is the human population. The former churn out lots of manure, and the latter insist on driving more and larger motor vehicles. Both produce acid-causing NO_x. Jill Baron, a USGS ecologist in Fort Collins, Colorado, and colleagues are studying 300- to 700-year-old spruces in the Rockies. In the journal *Ecosystems* last fall, they said trees downwind of populous areas show high levels of nitrogen and low ratios of magnesium in their needles. Nearby streams are also showing dramatic changes in their populations of diatoms, shifting from species that do well in the region's usually nutrient poor waters to those common in overfertilized waters. "Too bad most people get a lot less excited about diatoms than about fish," says Baron. "We're not nearly as bad as the East, but we're beginning a trajectory that will take us there."

The Northeast research team has assembled its data into a model to project the possible impact of various emissions cuts. Lead author Charles Driscoll, director of Syracuse University's Center for Environmental Systems Engineering, says that at current regulatory levels, the most sensitive environments such as Hubbard Brook will probably cleanse themselves, but very slowly. Chemical balances might return by about 2060, he says; after that, lake zooplankton might come back within 10 years; some fish populations, 5 or 10 years after that. If Congress were to call for an 80% SO_2 reduction from power plants below the current target for 2010, streams would probably bounce back by 2025, and some biological recovery in them might come by 2050.

"The question of soil and trees is a lot harder to answer," says Driscoll. In a communication to *Nature* last October, John Stoddard, an EPA scientist in Corvallis, Oregon, suggested that some soils with high sulfur-adsorbing capacities such as those in the Southeast might take centuries to recover.

The *BioScience* study received major attention on Capitol Hill, where momentum for stricter air controls has been building. Just before the study came out, President George W. Bush announced that he was breaking his campaign promise to limit CO_2 emissions—produced largely by the same power plants implicated in acid rain—raising the political stakes in the debate. With the 1990 Clean Air Act amendments up for reauthorization this spring, a half-dozen bills have been knocking around, proposing 40% to 65% reductions in both SO_2 and NO_x. On 15 March, New York Representative Sherwood Boehlert and Vermont Senator James Jeffords, both Republicans, introduced companion proposals calling for a 75% cut in SO_2 below what is currently mandated and a 75% cut in NO_x from recent levels—and a rollback of CO_2 to 1990 levels. Boehlert, head of the House Committee on Science, said the *BioScience* paper "is a wake-up call, and it should lead anyone who truly believes in science-based policy to support acid rain control."

Bush has said he will support stricter acid controls, although he hasn't mentioned any numbers. Moderate Republicans, who are furious that he reneged on CO_2, vow to keep all the pollutants tied together—a strategy that could greatly complicate a solution. Dan Riedinger, a spokesperson for the power industry's Edison Electric Institute, says the call for huge reductions now "is a little premature." He points out that ozone-curbing regulations scheduled to start in 2004 will also cut acid emissions and that some controls mandated in 1990 kicked in only last year. "The current program needs to be given more time to work," he says. "We always knew it would take decades." That last part may be the only thing on which everyone agrees.

–KEVIN KRAJICK

Kevin Krajick is a writer in New York City.

OBJECT RECOGNITION

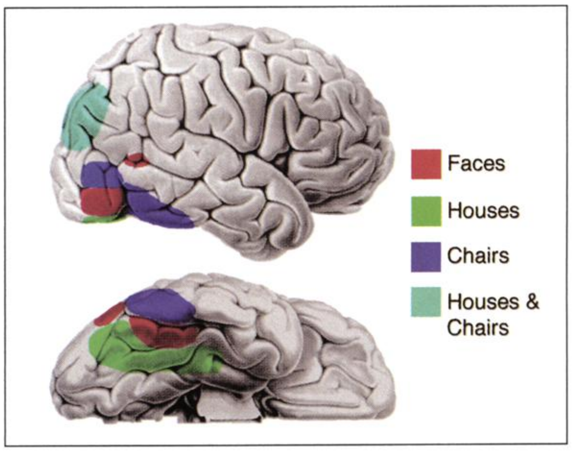
Where the Brain Tells a Face From a Place

Cognitive neuroscientists are beginning to figure out how the brain recognizes a chair as a chair

NEW YORK CITY—It's a complicated world out there, visually, full of things that look a lot alike. Yet people rarely identify a TV remote control as a cell phone or confuse a pencil with a swizzle stick.

The brain makes sense of this jumble of incoming visual stimulation with the help of an approximately 20-square-centimeter patch of tissue called the ventral temporal cortex. It lies just internal to the ears, on the bottom surface of the brain. In the past few years, brain imaging studies have identified one region of this tissue that specializes in recognizing faces and another that processes places. More recently, researchers have found that even mundane objects such as shoes, chairs, and plastic bottles also light up distinct areas in this part of the brain. But as Nancy Kanwisher of the Massachusetts Institute of Technology (MIT) points out, "it's ridiculous to think that there's an area of the brain for every conceivable category of objects."

So just how does the brain know that a chair is a chair? Researchers aren't sure how object recognition works, but several presentations on 27 March at the Cognitive Neuro-



What is it? Faces, places, and chairs activate different areas of the ventral temporal cortex, shown from the side and from below.

CREDIT: J. HAXBY

science Society meeting here brought them closer to an answer. Some speakers reviewed a classic debate about whether face areas are specialized for faces or for making detailed discriminations within a category. Another study—using a new technique for analyzing the entire landscape of activity in the ventral temporal cortex, rather than just the areas that light up the most—suggests that different parts of the area may respond to certain features of an object. And one researcher identified what some of those features might be that allow the ventral temporal cortex to recognize objects.

Psychologist Bruce McCandliss of Cornell University compares figuring out how the ventral temporal cortex works to a huge mapping project. "The first explorers came in and found mountain peaks [of activation] and put their names on them. Then someone else came in and noticed the valleys. Now other people are starting to look at the whole landscape and say, 'Hey, here are some basic geothermal principles' " that explain why certain peaks and troughs of activation correspond to different types of visual objects. "We're just starting to get to that level," McCandliss says.

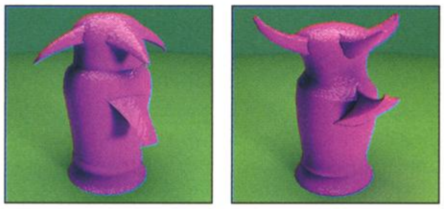
Navigating, social primates

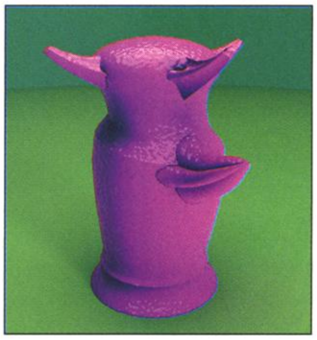
People are experts at recognizing faces. They discriminate faces quickly and accurately, yet if you could see through the eye stalks of some alien, human faces would look almost identical. Early evidence that this ability is localized in the brain came from certain stroke patients; strokes that hit the ventral temporal cortex can cause a syndrome called prosopagnosia—the inability to recognize faces.

It's tricky to figure out which brain region within a large lesion once processed faces, however, so researchers have turned to functional magnetic resonance imaging (fMRI) for a more precise determination. The technique reveals, voxel by voxel (like a computer screen's pixel-by-pixel display), which virtual boxes of brain are most active when someone is looking at a particular type of object. Kanwisher and her colleagues, for example, have used functional brain imaging to pinpoint an area in the ventral temporal cortex that lights up most when people view normal faces as opposed to scrambled faces, hands, houses, or other objects.

A few centimeters away from the face area, a region of cortex lights up when people view all kinds of buildings and landscapes. This place area doesn't give a hoot or an action potential about faces, and the face area likewise doesn't zing when someone's looking at a place—further supporting the notion that these areas are highly specialized.

So where did face-specific and place-specific areas in the brain come from? Kanwisher says "there are two very compelling, very different stories": experience and evolution. Evolutionarily, faces and places are "the most important categories that navigating, social primates have to recognize." But a lifetime of experience could explain the brain's specialization as well. After all, people recognize their friends and find their way to the bus stop every day.





Individuals. Greeble experts use the face area when viewing the critters.

CREDITS: S. YU, M. TARR, AND I. GAUTHIER

Both probably play a role. Newborn babies prefer to look at pictures of faces compared to other objects, supporting the idea that people are born with some predisposition to favor faces. But children who had cataracts for the first few months of life have subtle difficulties in discriminating similar faces, suggesting that experience trains face processing as well.

Faces, birds, and greebles

Not everyone agrees that the brain necessarily treats faces differently from other objects. The face area does respond robustly to faces, says Isabel Gauthier of Vanderbilt University in Nashville, Tennessee, but "it looks like it's not coding for faceness per se." Rather, she suggests that faces are special because of how people look at them. Every snowflake may have a unique shape, but people still see each one as snow. In contrast, people identify faces individually.

Suspecting that the face area specializes in making fine-grained distinctions among individuals in a category, Gauthier and her colleagues tested experts in nonface categories: birdwatchers and car enthusiasts. When expert birders looked at pictures of cars, their face areas just shrugged. But when birders saw pictures of songbirds, the level of activity in their face areas jumped. The opposite was true for carwatchers, showing that the face area isn't tuned only to faces, the team reported last year.

The subjects in this experiment had about 20 years of experience with birds or cars. The researchers wanted to know how quickly the brain can authorize the face area to respond to new stimuli, so they designed a category of similar objects called greebles (see photos). Greebles have a few different features that can be configured in slightly different patterns. At first, they all look pretty much alike. But with about 8 hours of practice, subjects can identify individual greebles and say what family they're in and what gender they are. (Greebles are social creatures.)

Gauthier and her colleagues tested whether greeble experts used the face area to distinguish among the little critters—and they do. At the conference, she reviewed these studies and suggested that the critical factor linking greebles, birds, cars, and faces is the strategy experts use to differentiate among objects in the category. Experts don't focus on individual features but recognize the bird or car as a whole. She speculates that someone who took up antique dealing or radiology would likewise, with practice, use the same recognition strategies and thus activate the face area when distinguishing Louis XIV chairs or spotting tumors on a computed tomography scan. "Maybe there is an innate disposition for faces," she says, "but that can't be the entire story."

Mountain peaks or landscapes

The ventral temporal cortex doesn't fire its neurons exclusively to faces and other expertly recognized objects. Several groups have found distinct patterns of activation for many types of objects, although the activation isn't as strong or as localized as that for faces and places. These studies—like those that have mapped the face-specific areas—traditionally record voxels that surpass some threshold of activation when a subject looks at a particular object compared to some other object. In contrast, Jim Haxby's group at the National Institute of Mental Health has developed a technique that surveys the entire topography of activation in the ventral temporal cortex—the hills and valleys as well as just the peaks of activity. Haxby and his colleagues looked at this broader pattern of activity when they showed subjects pictures of shoes, plastic bottles, faces, places, and other objects, and they came up with some intriguing results.

Haxby reported that he could predict from the pattern of activity which category of object a person was looking at. Furthermore, if he excluded the voxels corresponding to the face area, he could still use the activation in the rest of the ventral temporal cortex to predict whether someone was looking at a face, suggesting that the entire area participates in face recognition. And if he excluded all voxels except those in the face area, he could use the face area's activation to predict whether someone was looking at a shoe or a cat, say.

Analyzing fMRI data in these new ways demonstrates that the brain can maintain "unique representations of an essentially unlimited variety of faces and other objects," Haxby says. He suggests that the ventral temporal cortex may be organized according to yet-unknown features, just as other parts of the visual system are tuned to edges or orientations or colors.

"This is an important set of findings," says MIT's Kanwisher. "People have been making lots of loose talk [that representations of objects can be distributed widely in the brain], but this is the first serious demonstration I've seen that the information is present in many areas of the ventral pathway."

What sorts of features might the ventral temporal cortex be tuned to? Rafi Malach of the Weizmann Institute of Science in Rehovot, Israel, presented some of the first clues. Face and place areas aren't in the exact same spots in everyone's brains, but the face area is almost always slightly lateral to the place area. Malach suspected that this might have something to do with the fact that people usually see faces in the center of their visual fields, but when they look at a landscape, they scan a much larger area. He presented people with the same pictures either in the center of their visual field or at the edges. Central images activated parts of the ventral temporal cortex close to the face area, while images at the edge of the visual field activated place areas.

Haxby suggests that the ventral temporal cortex isn't organized as a patchwork of specialized face, place, and shoe areas, but as a distributed map of different features, such as where something usually falls in the visual field, as Malach's work suggests. In this way, this part of the brain could represent a panoply of objects and categories according to how much they activate different feature-sensitive spots.

With studies such as Haxby's and Malach's, "people are moving to a framework level" of understanding object representation, says Cornell's McCandliss. But it will be some time before they know for sure how the brain tells a warbler from a greeble.

–LAURA HELMUTH

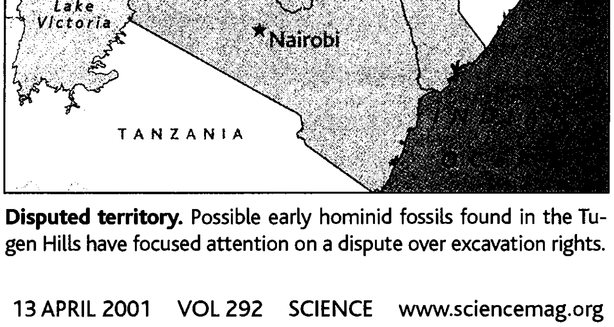
PALEONTOLOGY

Paleontological Rift in the Rift Valley

A bitter dispute over rights to hunt for fossils in the Tugen Hills indicates that the old way of regulating paleontology in Kenya is in flux

TUGEN HILLS AND NAIROBI, KENYA—Martin Pickford stands in the middle of a long, dry gully lined with tamarind and acacia trees. A light breeze ushers a handful of cottony clouds across the blue African sky toward Lake Baringo, some 20 kilometers to the east. Pickford points with a sunburned arm to a spot on the gully's bank. "That is where we found the humerus," he says proudly. "And just over here, one of the femurs and an upper canine tooth, and further down there, parts of the mandible and the molars." Last October, a team led by Pickford, a geologist at the Collège de France in Paris, and Brigitte Senut, a paleontologist at France's National Museum of Natural History, found 13 fossil fragments of what they believe is the earliest known ancestor of modern humans. Although scientists are still debating whether the fossils belong to the human family (*Science*, 23 February, p. 1460), their undisputed age of about 6 million years—roughly the time when genetic evidence suggests that the human line split from that of the chimpanzees—means that these remains could help researchers untangle the increasingly twisted roots of the human evolutionary tree. And just last month, during a 2-week season here at the foot of Kenya's rugged Tugen Hills, Pickford and Senut found several more fossils—including the middle portion of a lower jaw—that they believe also belong to this claimed early hominid, which they have named *Orrorin tugenensis*.

Such a dramatic find would normally be cause for rejoicing among human origins researchers. Instead, *Orrorin*'s discovery has set off a bitter internecine battle. Pickford and Senut's very right to excavate here has been challenged by some other scientists, most notably anthropologist Andrew Hill of Yale University, who claims that the pair is encroaching on turf his team has been studying since the 1980s. Hill and other researchers argue that Pickford and Senut have flouted long-established rules governing paleontology research in Kenya. Pickford and Senut deny these charges, countering that they have acted legally and followed all required procedures. They maintain that a campaign against them has been orchestrated primarily by paleontologist Richard Leakey, a claim Leakey vehemently denies.



Disputed territory. Possible early hominid fossils found in the Tugen Hills have focused attention on a dispute over excavation rights.

Turf battles among paleoanthropologists are nothing new. For decades, scientists working up and down the great Rift Valley of Africa and Asia—where many of the world's most important hominid fossils have been found—have fought over the right to unearth these precious keys to humanity's evolutionary past. The fossil wars have left wounds that have taken years to heal (*Science*, 14 January 1983, p. 147; 11 December 1987, p. 1502; and 14 April 1995, p. 196). But the fight over the Tugen Hills seems to run deeper than most of these other disputes, and it has implications for the way paleontology will be managed and conducted in a country that holds vital importance for the field.

Pickford and Senut see the battle as a struggle over the power of the National Museums of Kenya (NMK) and the Leakey family, which pioneered paleontology in Kenya and has long dominated the NMK. The NMK has traditionally held virtual veto power over permit applications, and it is the official repository for fossils unearthed in the country. Pickford and Senut's work is being supported by a rival museum system—called the Community Muse-