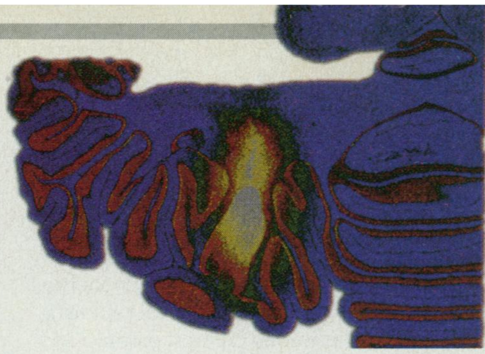
NEUROSCIENCE

The Remembrance of Blinks Past



KRUPA, THOMPSON AND THOMPSON

Storage room. Memories seem to be stored in a portion of a rabbit's cerebellum *(light area).*

One of the hottest areas of neuroscience is the quest to understand where memories are stored in the brain. One potential site that has been the subject of much controversy is the cerebellum. Some have argued that this structure at the base of the brain, which is involved in coordinating motion, also stores memories involving movement. But other researchers have strongly disagreed. In this issue of *Science* (p. 989) Richard Thompson and his colleagues at the University of Southern California present evidence pinpointing a memory to a small area of the cerebellum. Yet some critics of the idea of cerebellar memory remain unconvinced.

Thompson's work centers on a simple conditioned reflex, using rabbits as an experimental model. Puff air in a rabbit's eye, and the animal will blink. And if the puff is consistently preceded by a tone from a loudspeaker, the rabbit soon learns to blink in response to the tone alone.

In the 1980s Thompson and others showed the simple type of learning that connects the puff and the blink could be blocked by damage to part of the cerebellum. But the possibility remained that the learning occurs somewhere else, and cerebellar damage was merely a roadblock in a neural pathway, preventing learned information stored beyond the cerebellum from reaching the brain-stem neurons that actually direct the movements.

To get around that problem, Thompson, with co-workers David Krupa and Judith Thompson, used a drug called muscimol to block temporarily different parts of the neural pathway from the cerebellum to the brain stem while they trained the rabbits. Since muscimol's effects wear off, the researchers could discover if they'd blocked memory formation or merely prevented transmission.

In separate experiments, the team used muscimol to deaden either a nucleus in the cerebellum or a structure in the brain stem called the red nucleus, which sits just beyond the cerebellum. When trained under the influence of the drug, all the rabbits barely blinked an eye when they heard the tone. When the muscimol wore off, rabbits whose red nucleus had been drugged blinked away when the tone sounded; they had learned the response perfectly, and the drug had merely blocked transmission of the information from higher up the path. But when the block had been in the cerebellum, the rejuvenated rabbits showed no signs that they'd learned anything at all. That means, argues Thompson, that the memory has to be stored in the cerebellum.

"It's a very clear-cut result, beautifully documented in this paper," says Stephen Lisberger, a neuroscientist at the University of California, San Francisco. As long as there are no unknown neural detours between the cerebellum and the red nucleus, he says, Thompson's conclusion is probably right. Larry Squire, who studies learning and memory at UC San Diego, agrees: "This is probably the best evidence yet that there is localization to the cerebellum." It presents a great object lesson, he adds, for how to seek memory sites elsewhere in the brain.

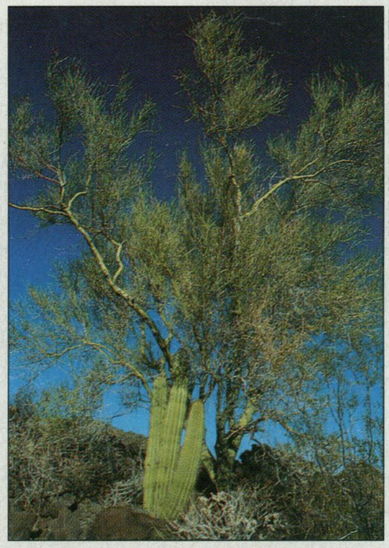
This enthusiasm, however, isn't universal. John Harvey of the Medical College of Pennsylvania and John Welsh of the New York University School of Medicine have argued that in earlier Thompson experiments the way he tested the animals may have biased the results. Although others say those concerns are resolved in the current paper and other recent work, Harvey and Welsh insist they still see "technical problems" with the new research. They refused to discuss their objections, saying they were preparing a technical rebuttal to Thompson's paper. So learning and memory fans should expect further debate in the cerebellar corner of their field.

–Marcia Barinaga

FORENSIC SCIENCE

Botanical Witness for the Prosecution

Sometime late on the night of 2 May 1992, a woman was killed and her body abandoned in the Arizona desert. A beeper, found near the body, pointed police to the man now on trial for the murder. But the key piece of evidence may be something far subtler and more scientific: DNA sequences from a few seed pods found rattling around the back of the same man's truck. In April of this year, Judge Susan Bolton of the Superior Court of Arizona's Maricopa County ruled that DNA profiles linking the seed pods to a Palo Verde tree near where the body was found could be admitted as evidence in the murder trial.



DOUG SOKELL/VISUALS UNLIMITED

Rugged individual. Palo Verde trees show a lot of genetic variation.

Bolton's decision appears to mark a scientific and judicial first. Although DNA profiles from samples of human tissue are widely used in criminal trials for rape and murder, the Maricopa case appears to be the first use of plant DNA in a criminal case. Those following the status of DNA profiles in the courtroom say the decision is a sign that additional novel applications of the technique are likely to appear as investigators become more aware of its possibilities and begin looking for other kinds of biological evidence from which DNA can be extracted.

When the Maricopa County Sheriff's office first asked molecular geneticist Tim Helentjaris of the University of Arizona, Tucson, to look into the possibility of using DNA profiles to try to match the seed pods in the defendant's truck to an individual specimen of the Palo Verde tree—a bizarre, often leafless tree that can photosynthesize through its branches—at the crime scene, Helentjaris replied that he wasn't sure the job could be done. For one thing, he didn't know whether he could get enough DNA for the analysis from the seed pods. And he also worried that the plants wouldn't have sufficient genetic variability to identify an individual through its DNA profile. But as he pursued his research, Helentjaris learned that Palo Verde trees show a high degree of genetic variation—which made it possible for the pods to take the stand in the trial.

Helentjaris, whose lab has been mapping plant genomes, analyzed the Palo Verde DNA with a technique known as Randomly Amplified Polymorphic DNA, or RAPD, a technique involving the PCR gene amplification method. RAPD uses generic DNA primers that contain as few as 10 bases and thus bind to many sites in the genome. Under the proper binding conditions, each primer produces a reproducible profile of amplified fragments. Helentjaris says that by using multiple