Science News®

A Science Service Publication
Vol. 107/February 8, 1975/No. 6
Incorporating Science News Letter

Of the Week

Research Notes

Articles

COVER: It takes about 20 minutes at the speed of light for flight controllers on earth to find out what a spa.e probe around Mars is seeing, and another 20 for them to tell the probe what to do about it. At that rate, a landing at a spe ific site becomes a tricky business. Roger Schappell of Martin Marietta Aerospa e hopes to ease navigators' woes with a device that would let the probe find its own way down by comparing the photographic contrasts of the site with memorized images from previous orbiters. See p. 90. (Photo: Martin Marietta)

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Printed in U.S.A. Second class postage paid at Washington, D.C. Established as Science News Letter ® in mimeograph form March 13, 1922. Title registered as trademark U.S. and Canadian Patent Offices.

Published every Saturday by SCIENCE SERVICE, Inc., 1719 N St., N.W., Washington, D.C. 20036. (202-785-2255). Cable SCIENSERV.

Science News of the Week

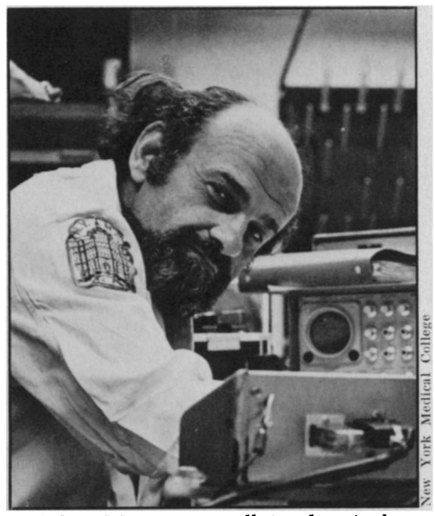
Memory: Nerve firing patterns

One of the prominent investigators into the electrical manifestations of memory is E. Roy John, a neuropsychologist with the New York Medical College. John has been gathering increasing evidence during the past two decades that memory is manifested as a pattern of neuron firing in the brain, rather than the firing of specific neurons. He reports strong new evidence for this theory in the Jan. 24 SCIENCE.

John first reasoned: If average firing patterns of populations of neurons constitute memories, it should be possible to elicit performance of previously learned behaviors by stimulating the brain with electrical inputs that simulate the firing patterns. He tested this theory on six cats. The cats were trained to respond to flashes (a visual cue) or to clicks (an auditory cue). What they learned resulted in specific nerve firing patterns in their neurons. John then simulated the firing patterns by electrically stimulating various regions of their brains. Out of 300 simulation trials, the cats performed as they had been trained in 235 of them (78 percent). This result strongly suggested that average firing patterns constitute memories.

John went a step further, however, to show that the patterns were truly memories rather than mimicked sensations. He simulated the firing patterns of the neurons in the animals' brains while also presenting the animals with the actual visual and auditory cues that they had learned. John found that the electrical simulation could control the animals' behavior even if they were presented with auditory or visual stimuli. Because the simulation was effective no matter what stimuli it was contradicting, John concluded that it was more likely activation of a memory than a mimicking of a sensation.

After he had shown that he could control the animals' behavior with the simulated firing patterns, he introduced the simulations into different portions of the animals' brains. He recorded the electrical behavior of the simulations and found that the area of the brain where they were most effective was the reticular formation. The reticular formation lies like a core between the pons and the thalamus and receives sensory messages from other parts of the brain. "This is the area of the brain that received a lot of attention 15 years ago," John says. "If it was damaged, an animal lost consciousness. I have now shown that the region is capable of processing information, and that electrical stimulation of the region is uniquely effective in controlling animals' behavior."



John: Memory recall is electrical.

John has done still another experiment, not yet published, that also supports the theory that firing patterns in the reticular formation constitute memory. He trained cats to go to the left if presented with two brain pulses, and to the right if presented with four brain pulses. Then he presented two pulses to one region of the animals' brains and two pulses to another area of their brains. Consequently each animal's total brain received four pulses, which says go to the right. And as John expected the animals went to the right, showing that the electrical information was being integrated somewhere in their brains. John then looked for nerve firing patterns that might represent this memory recall. And he found them in the reticular formation.

"No matter what part of an animal's brain you stimulate," John says, "the electrical evidence of that integration appears in the same place—the reticular formation."

John says that his evidence complements, rather than contradicts, evidence that memory is chemical (SN: 10/6/73, p. 218). "Memory storage is chemical," he says, "and probably involves the synthesis of protein. But the manifestation—the recall—of the stored memory is electrical." □

For the second consecutive week an expanded news section has crowded out our Letters to the Editor column. We expect to resume the letters column next week.—Ed.