RESEARCH NOTES

Psychobiologist Evelyn Lee-Teng offers a simulated seed to a baby chick as part of her study of memory processes.

MEMORY CONSOLIDATION

Thirty seconds seems to be the minimum time required by the brain to form a permanent record of something that it needs to remember. Evelyn Lee-Teng, Caltech researcher in psychobiology, has determined this time span precisely in a study involving more than 2,000 baby chicks. This large number of subjects made it possible to define the time accurately. Other investigators have tried to measure the time span using rats and humans as subjects.

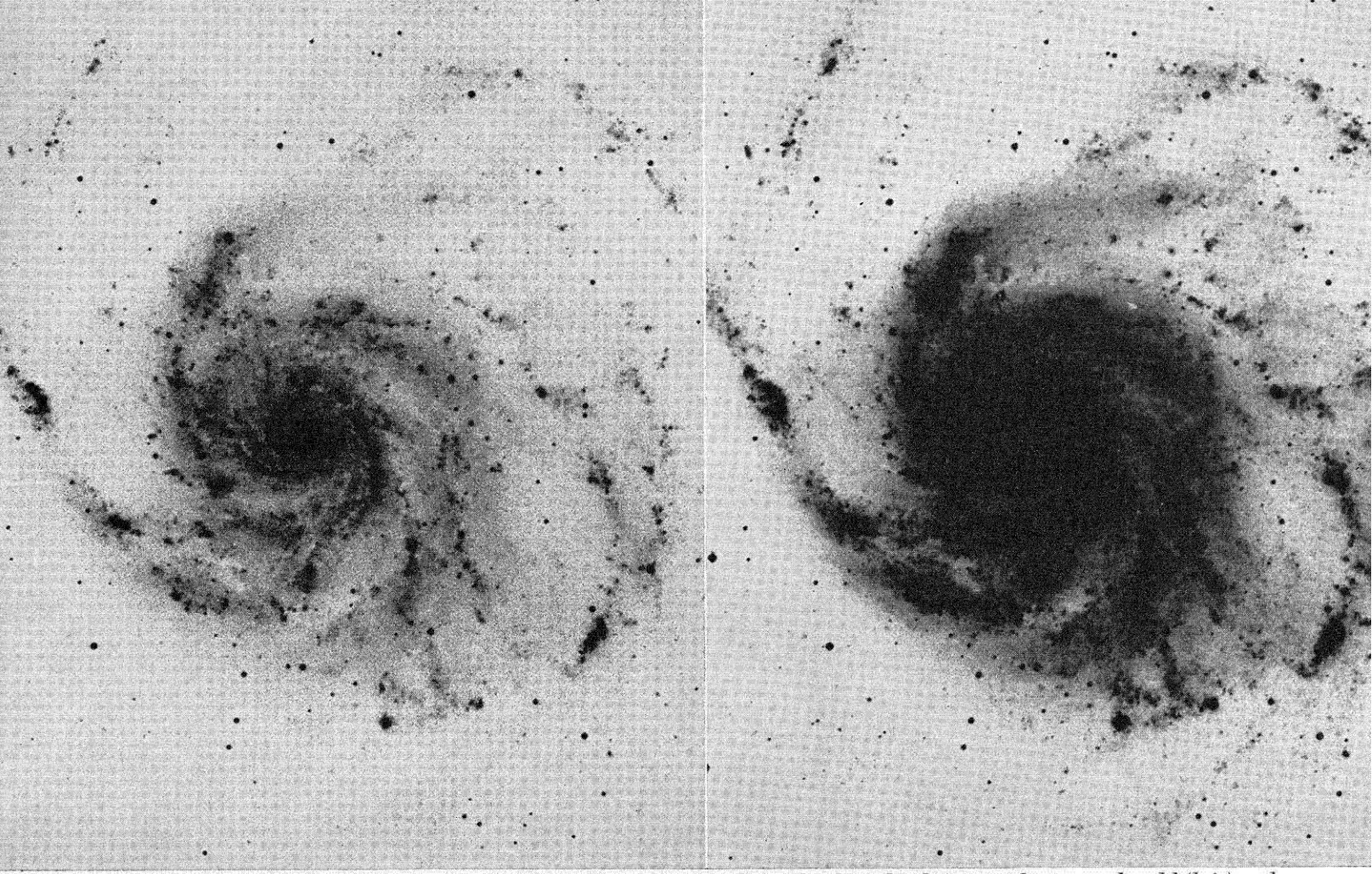
"Many experiments suggest the presence of a basic elemental process in the formation of memory traces that is common to all vertebrate brains —chicken and man alike," commented Roger W. Sperry, Hixon professor of psychobiology. "Dr. Lee-Teng's precise determination of the time required by the brain to lay down a permanent record in memory in the simple, basic form described in these experiments gives an important clue to the nature of the unknown memory processes."

Little is known about how memory works, although it is generally believed there are at least two underlying processes, one short-term and the other long-term. The short-term memory is perhaps electrical and may persist for a few seconds or minutes; the long-term memory is probably chemical and may also involve structural changes.

The research involved electroshock, similar to that used as a treatment for humans undergoing psychotherapy. It was employed in this case because the electric current sweeping through the brain wipes out those consolidation processes under way at the time the treatment is administered, without affecting established memory.

The research grew out of earlier investigations in which attempts were made to use quick-acting anesthetics, rather than electroshock, to interrupt the consolidation of the memory trace. Dr. Lee-Teng's collaborator in that work was Dr. Arthur Cherkin, a chemist. In the present work her associate was S. Murray Sherman, now a graduate student at the University of Pennsylvania. The research is supported by the National Institute of Mental Health.

The investigators took advantage of a strong instinct in chicks to peck at anything resembling a seed. They presented a shiny, seed-sized metal ball



CALTECH ASTRONOMERS *can now record celestial objects three times fainter than before with a new photographic emulsion developed by Eastman Kodak. The new material emphasizes very faint objects against the glow of the night sky. The difference between the old (left) and new emulsion is shown here in increased detail in the outer spiral arms of galaxy Messier 101, photographed with the 48-inch Schmidt telescope.*

to the chicks after it had been dipped in a highly unpalatable substance. Having tried it once, chicks ordinarily would not peck at it again. Each chick was given the chance to peck the ball once. Then its memory was allowed to gel for a certain measured period of time before electroshock was applied. The shock apparently wiped out the memory if it had not had sufficient time to become fixed in the brain.

The results, which were consistent in repeated tests, indicated that the brain began laying down the memory trace right after the original peck but that the trace was not finally "cemented in" until 30 seconds had elapsed.

Dr. Lee-Teng stressed that it is reasonable to expect that the time period will vary with the complexity of the learning tasks and with different forms of disruptive treatment. Comparing results from different experiments may lead to a better understanding of memory mechanism.

ANCIENT MOUNTAINS

The remnants of a mountain range 1.65 billion years old have been found in southern California. These mountains are by far the oldest known on the west coast of North or South America. The peaks of the range, which once extended eastward at least into Colorado, were eroded long ago. All that remain now are altered residuals of the granitic roots, which have been lifted to the surface of the very young San Gabriel Mountains by vertical movements along the San Andreas fault and other faults associated with it.

Leon Silver, Caltech professor of geology, made the discovery in the course of his continuing study of the origins of continents. In 1961 he and his colleagues found remains—also in the San Gabriel Mountains—of another mountain chain, formed 1.2 billion years ago, that may have extended across the entire continent.

The age of the mountains was determined by isotopic analysis of minute zircon crystals in rock samples. Dr. Silver measured the ratios of radioactive uranium and thorium isotopes to their decay products, lead isotopes. The amount of lead relative to its parent indicates how long ago the minerals first crystallized in molten granite emplaced during the mountain-forming episode.