Nerve Cells and Parkinsonism

by Patricia McBroom

Once it was considered the seat of the soul; then more scientific minds identified it as the source of Parkinson's disease. But the corpus striatum, lying deep within the brain, has remained one of the most neglected areas of brain research.

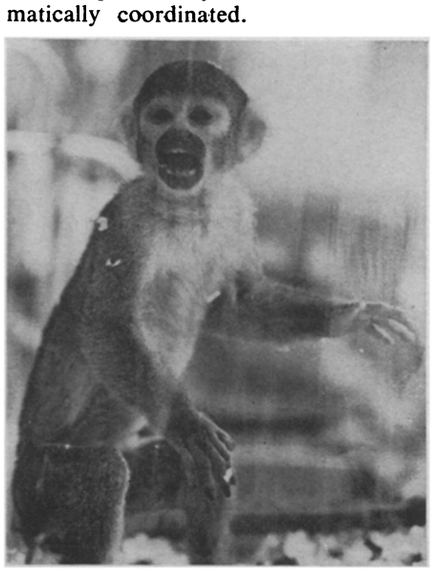
Last week a Columbia University neurological symposium, which brought scientists from many parts of the world to New York, lifted some of the mystery surrounding this "core of the brain" and its links to other brain structures.

The symposium offered hope that an answer to Parkinsonism—sometimes called "shaking palsy"—can be found. "We must not think the solution is just around the corner," warned Nobel laureate Sir John C. Eccles, Australian-born director of the Institute for Biomedical Research in Chicago, "but we are going in the right direction."

Besides the corpus striatum, the "right direction" refers to new understanding of the brain's capacity to block cellular activity, as well as promote it. "Some of the most important functions of the brain are those involved in inhibition," said Dr. Eccles.

There is some indication, in fact, that the corpus striatum is involved in inhibiting motor centers.

Just how much inhibition contributes to movement was illustrated by Dr. Eccles in his analysis of the cerebellum —the lowly placed bulb whose function is to keep the body balanced and automatically coordinated.



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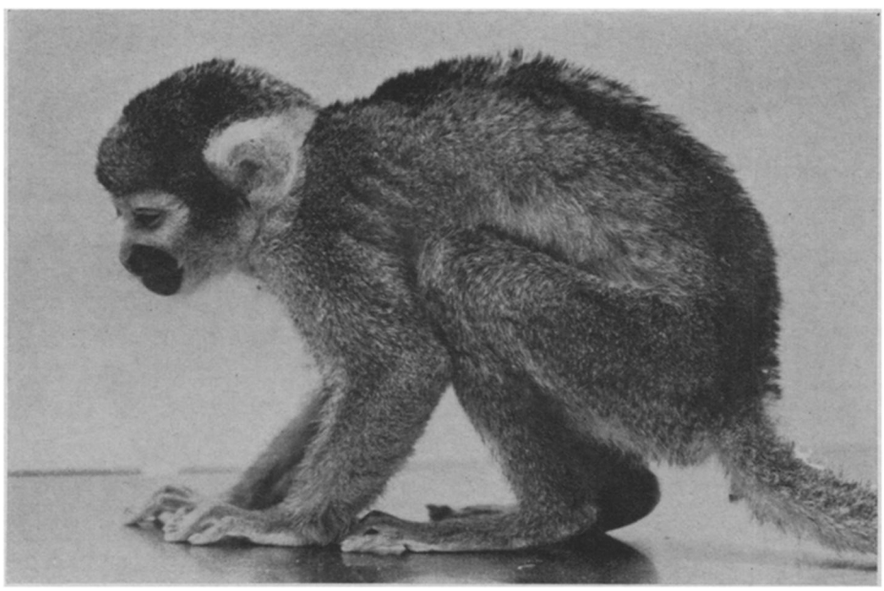
The same monkey before injection.



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A squirrel monkey shows Parkinson-like symptoms after a drug injection.

The cerebellum has no memories, no "learning." It is continually "computing, computing, computing," he said, describing in detail the fine balance the cerebellum maintains between excitory and inhibitory cells. Each positive cell is directly connected to a negative one that blocks or inhibits. A single positive fiber carrying impulses into the cerebellum is capable of firing 324 times a second, he said. But its inhibitory companion can cut that number by 75 percent.

The end result is precision—neither too much motion nor too little.

But the corpus striatum, which handles different kinds of movement, has none of the "structural niceties" of the cerebellum, noted Dr. Dominick P. Purpura, a neurophysiologist at Columbia University and one of the symposium's organizers.

The corpus striatum is an old system by evolutionary standards. Composed of extremely small nerve cells and fine fibers, it hasn't the "express train" action of more powerful motor nerves, said Dr. Purpura.

Instead it seems to provide a kind of "background" for whatever else the brain does in movement. One of the striatum's component parts, the caudate, appears to be an inhibitor, but other than that, the function of the caudate is a mystery, said Dr. Purpura.

He and his associates, however, were able to establish a physical link between the caudate and another part of the brain, thought to be the source of an important brain chemical—dopamine—implicated in Parkinson's disease.

Upon autopsy, victims of Parkinsonism have shown a substantial lack of dopamine in the corpus striatum. By implanting microelectrodes in single nerve cells, Dr. Purpura found very fine nerve fibers joining the corpus striatum to the dopamine source. He thus strengthened the theory that Parkinsonian is a biochemical disorder.

If this is the case, then dopamine, as other scientists have theorized, could be the chemical that provides essential inhibition. When it is lost, tremors and rigidity result.

A particularly intriguing example of inhibition came from Italy. Dr. Ottavio Pompeiano of the University of Pisa discovered unexpectedly that sensory input to the brain is blocked during the dreaming phase of sleep—precisely when the eyes are rolling back and forth and muscles are twitching. In other words, a group of hyperactive motor cells was blocking just that sensory information needed to make correct movements.

If the dream is pleasant, that's all to the good, but can the vestibular nuclei block sensory input during waking hours? Dr. Pompeiano plans to study the question.

Clearly, Dr. Purpura concluded, the answer to Parkinsonism cannot be found in any one cell group; many are implicated. The nervous system, said Dr. Eccles, is "more complicated than all of space travel."