

Penfield believed epilepsy was not a disease but a symptom of something awry in the brain. And his persistent investigations have shown that epilepsy is literally an electrical explosion brought on by a too heavy charge accumulating frequently in a damaged part of the brain. The damage in more than half of his patients is attributable to inadequate oxygen or improper head compression at birth.

The surgical procedure Dr. Penfield developed is known as the Foerster-Penfield operation. It was first performed by Dr. Otfried Foerster in Germany. Dr. Penfield helped Foerster to analyze his results while he was studying neurosurgery there. Until 1934 the results were not promising but today half of the patients selected for operation from among those not responding to the anti-convulsant drugs are cured by operation. In another 25 per cent the operation cuts the number and severity of seizures.

On recommendations of their physicians, patients come to the MNI from all over the world. One of the earliest of these was a middle-aged housewife, and it was halfway through this operation that the historic incident took place which has helped us understand the miracle of human memory.

Dr. Penfield's probing electrode touched a spot on one of the two temporal lobes, above the ears. At once the housewife exclaimed in surprise that she seemed to be having her baby all over again. She went on to describe the sights and sounds of the delivery room—vividly, exactly and in detail, as if the events were taking place again before her eyes.

Dr. Penfield knew that when certain parts of the brain were touched with the electrode he could cause a leg to jump, an eye to wink. Such responses had been carefully plotted on an atlas of the cerebral cortex showing which parts of the gray matter governed different body functions. But the vivid recall of an incident that had happened years ago was completely unexpected.

Soon a succession of similar incidents occurred. A young South African suddenly saw himself back in a family gathering, heard the piano playing.

"No, doctor," he exclaimed in wonder, "I am not just remembering it. It is happening again in this room. I know I am in Montreal but I seem to be with my friends too. I can see and hear them."

A secretary recreated a period when she once had to wait hours in a snowbound station. A businessman relived a forgotten moment of his childhood when he saw a strange man coming through the fence at a baseball game.

Dr. Penfield would tell his patients he was going to touch the same spot with the electrode again and then ask them what they saw or heard now. Since the brain itself is incapable of feeling anything, the patient had no way of knowing that Dr. Penfield was deliberately withholding the electrode. Yet each time, the patient would report that he saw and heard nothing. But when Dr. Penfield did retouch the spot, he would get a repetition of the sights and sounds the patient had reported previously.

One young woman reported she was in the living room of a house her family had lived in more than 15 years before and that a phonograph was playing the march from *Aida*. She hummed it as she listened inwardly. When the electrode was removed the music stopped. When it was reapplied she heard the music again—where it had begun previously. Dozens of similar instances finally convinced Dr. Penfield that he had stumbled on a completely new phenomenon.

Every day our eyes take a half million snapshots. Our ears bring the accompanying sound to an adjoining part of the temporal lobes. Somehow the sound is synchronized with the "film" so that the two are always together when there is a memory playback. Two experiences ("strips of time," Dr. Penfield calls them) are never activated at the same time.

"Among the millions of nerve cells that clothe parts of the brain there runs a thread," Dr. Penfield says. "It is the thread of time, the thread that has run through each succeeding wakeful hour of the individual's past life. When my electrode activates some portion of that thread, there is a response as though the thread were a wire recorder, or a strip of movie film on which are registered all those things which the person selected for his attention in that interval of time."

Simultaneously as the "film" and sound track are permanently recorded in the brain several "indexes" are probably also created, Dr. Penfield believes, so that the mind can find a particular living memory quickly.