

Neuroscience: "The Brain Deboggles"

The human brain, the most complex organism on the face of the earth, has eluded attempts to understand it for centuries. But today, the mysteries of the brain are being unravelled in quantum leaps, with new discoveries and pioneering medical treatments reported almost weekly. Fuelling advances in neuroscience are the exciting medical applications of today's advanced technology, the emergence of new genetic engineering techniques, and the minds of researchers and surgeons alike.

Mapping the Brain

One of the more exciting of the new tools and techniques available to medical science is Positron Emission Tomography (PET). PET scanners can recreate a shifting, colour picture of the living human brain on a computer screen.

The revolutionary PET system has recently helped Canadian researchers make major advances in the fight against Parkinson's disease. In Parkinson's victims, the brain cells that produce dopamine — a key chemical in the brain's internal communication system — die, resulting in a progressive loss of muscle control, tremors, slowness of movement and memory impairment.

In the early 1980s, Dr. Stephen Garnett, Chief of nuclear medicine at McMaster University Medical Centre in Hamilton, Ontario, played a key role in developing fluoro-L-dopa — a radioactive version of a drug that partly makes up for the loss of



Ottawa Civic Hospital implant team with Dr. Benoit (left) and Dr. Grimes in foreground.

dopamine. The discovery enabled researchers to study the brain abnormalities of Parkinson's victims with PET scans. Today, doctors consider Parkinson's to be the best-understood neurological disease of all, though the reason dopamine-producing cells die remains a mystery.

Other Canadian researchers are determined to solve this mystery by applying PET technology to unlikely clues. In 1982, an illicit drug containing methylphenyltetrahydropyridine (MPTP) caused users to develop symptoms of Parkinson's. Using PET scans, Donald Calne, a professor of medicine at the University of British Columbia's (UBC) Health Science Centre, discovered brain abnormalities which led him to predict that the users may develop

Parkinson's in later life. As a result, many researchers now believe that pyridine in MPTP may play a role in causing the disease.

Decoding Genetic Secrets

Perhaps the most exciting advancements in the exploration of the human brain have come from new genetic engineering techniques which enable scientists to examine, and perhaps someday repair, the genes that contribute to brain disorders. Like all human tissue, brain cells — or neurons — function according to instructions issued by genes lodged in the nucleus of every nerve cell. Using advanced genetic engineering techniques, scientists can now extract samples of the gene-bearing substance, deoxyribonucleic acid (DNA), from a cell and replicate individual genes. Once isolated, genes can be examined and, in simple organisms, re-engineered to create new genetic characteristics.

This new biotechnology has revealed that many neurological diseases and mental illnesses may be the result of inherited characteristics. At the forefront of this rapidly growing field of research are Canadians who have made key discoveries in the study of Huntington's and Alzheimer's diseases, multiple sclerosis, Down's syndrome and schizophrenia.

One of the most dramatic demonstrations of the potential value of the new techniques took place in 1983. James Gusella, a Canadian neuroscientist working at Boston's Massachusetts General Hospital, decided to try to isolate the gene responsible for the debilitating Huntington's disease — an inherited degenerative brain disorder leading to involuntary movement of limbs, severe mental impairment and personality change.

From blood samples of a 7 000-member extended family with a history of Huntington's disease, Gusella's team was able to identify the site of the Huntington's gene in the DNA chain. Gusella, who studied biology at the universities of Ottawa and Toronto, is now working to track the gene itself. When found, it is expected to yield knowledge that could lead to improved treatment and even prevention of Huntington's. In the meantime, scientists at three North American hospitals, including UBC's Health Science Centre, are using this information to determine whether adults or fetuses are carrying the Huntington's gene.

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