Unlocking Genetic Mysteries

In recent years, the emergence of genetic engineering has had an enormous impact on medical research. Today, new tools and techniques are helping science discover how one's genetic make-up controls the body and senses, what causes some brain disorders and why some people go insane.

In Canada, more and more medical researchers are looking to genetics in an attempt to understand human resistance or susceptibility to disease. And they are reporting discoveries at an exponential rate. Now, Canadian investigators have begun zeroing in on the genes believed to be responsible for such grave disorders as multiple sclerosis, schizophrenia and Alzheimer's disease. Last year, scientists at the University of Toronto reported that they had isolated the gene responsible for producing S100 — a brain protein that may cause Down's syndrome (mongolism), a disorder that affects about one in every 800 to 1 000 live births. So rapid is the advance of knowledge about genetics that many investigators believe that soon researchers could have the knowledge needed to pinpoint the origins of many major illnesses.

Ultimately, it is hoped that genetic engineering techniques will enable scientists not only to identify defective genes but also — although it may take decades — to find ways to repair them. In the meantime, researchers are setting their sights on identification.

Cruel Disorders

Genetic defects have long been suspect in the transmission of major diseases such as multiple sclerosis (MS) and cystic fibrosis (CF). MS affects more than 50 000 young Canadians between the ages of 20 to 40, and occurs when myelin, the sheath-like cover on nerve fibres, breaks down. Much like insulation on a wire, myelin's function is to speed the transmission of electrical signals between nerves. Its degeneration, however, cuts off communication from the brain and central nervous system to the body's various parts causing gradual paralysis, as well as speech and sight problems.

At the forefront of MS genetic research is a team of scientists at the University of Toronto and at Montreal's McGill University who have cloned and mapped all the major genes found in myelin. Now they are looking at how these genes are regulated during myelin formation.

Dr. John Roder, a neurobiologist at Toronto's Mount Sinai Hospital and a member of the research team, believes that once scientists understand how genes operate during myelin formation and myelin breakdown, they may have a better idea of how to get myelination started again.

Another genetic approach is the one taken by Dr. George Ebers at the University of Western Ontario. Dr. Ebers has pioneered the genetics of MS susceptibility in collaboration with a number of MS clinics across Canada. The prominent researcher found that 28 per cent of identical twins are concordant for MS. According to Dr. Ebers and other experts, this ratio is a strong indication that multiple sclerosis is genetically determined.

Dr. John Roder is studying gene regulation during myelin formation.

Photo: Brian Willar

One of the most tragic childhood diseases is cystic fibrosis. A generalized illness that presents chronic respiratory infections and digestive problems, it is the most common genetic disorder in North America and affects one in every 2 000 children.

In 1985, renowned Canadian scientists Drs. Lap-Chee Tsui and Manuel Buchwald located the site of the cystic fibrosis gene on chromosome 7. This discovery led to a large-scale CF genetics research program based at the Toronto Hospital for Sick Children where a team of investigators now appears to be close to isolating the faulty "CF gene."

Under the direction of Dr. Jack Riorden, the team's aim is to locate the CF gene and to understand the resulting defective chain of biochemical reactions which leads to abnormal chloride transport in CF cells.

In victims of the disease, faulty chloride transport leads to the incorrect movement of salts and water across cell membranes. As a result, perspiration in persons with CF has too much salt and mucus does not have enough water. Thick mucus, in turn, damages the lungs and pancreas, and causes both breathing and digestive disorders.