

ECO ENIGMA

Searching for answers to neurological disease



The mystery started on the Pacific island of Guam in the 1950s. The native Chamorro people developed a deadly neurological disease that caused paralysis, tremors and dementia. Scientists suspected an environmental neurotoxin called BMAA. Formed from bacteria, the toxin jumped up the food chain, from plant seeds to fruit bats, from bats to humans, eventually lodging in the brains of the native islanders.

Over the years, scientists have debated BMAA's role in neurological disease. But one thing remains clear: the bacteria that naturally produce BMAA are found throughout the world, including in the blue-green algae of our lakes and waterways. BMAA has also been found in the brains of Canadians with Alzheimer's disease. Could BMAA or other environmental toxins be the key to stopping devastating neurological conditions such as Alzheimer's, Parkinson's or ALS?

Dr. Douglas Lobner, associate professor of biomedical sciences, is determined to find out.

Lobner studies the death of nerve cells and is known for his research on the neurotoxicity of dental materials (his research team was the first to show that dental amalgam was neurotoxic.) Until recently, his research on neurodegenerative diseases focused on methods that protect neurons, such as drugs that stave off disease. Two years ago, he decided to switch his focus to something more critical: the cause.

Researchers have long known that neurological diseases are caused by a combination of genetic and environmental factors.

"If your mother has Alzheimer's disease, you are more likely to get it," Lobner says. "But you may not. What determines that is almost certainly some environmental agent, and nobody knows what that is. For

me, finding the environmental trigger for these diseases is much more important than finding some other drug that delays the disease by a month."

Lobner is studying three suspected environmental villains: BMAA, mercury and pesticides. Because of a process called biomagnification, all three concentrate and become more potent as they travel up the food chain. One of the main criticisms of the BMAA theory is that even with biomagnification, it would be difficult to ingest enough of the toxin to cause neuronal death. Research shows that it takes high levels of BMAA to kill neurons.

But Lobner's research — funded by the National Institutes of Health — revealed something new. In a critical paper published last year in the journal *Neurobiology of Disease*, he showed that BMAA can have a synergistic effect, and thus it takes only low levels of BMAA to kill neurons when combined with other neurological insults that occur in the brains of patients with Alzheimer's and Parkinson's diseases.

That means a single culprit might not be to blame.

"Possibly eating a fish that has high levels of mercury and BMAA, and having a genetic predisposition to the disease might be the exact bad

combination that leads to the expression of the disease," Lobner says.

Lobner's team discovered three distinct mechanisms that make BMAA toxic. "One of the mechanisms by which it causes toxicity is through the production of free radicals," he explains. "That's an important mechanism because free radicals are almost certainly involved in the neuronal death that occurs in all of these diseases. That could be how BMAA is able to produce symptoms of all these different diseases."

Like mercury, BMAA isn't easy for the body to eliminate. "It can become incorporated into the protein of the brain and stay there for a long time, which may partially explain the delayed onset of these diseases," he says.

Until now, Lobner's research has used cortical cell cultures from mice. Next, he'd like to test whether low levels of BMAA also hasten the onset of disease in animal models.

"I'm not convinced that BMAA is what causes these diseases, but I think more studies need to be done," he says. "To figure out what is the environmental toxin that causes neurodegenerative diseases is a very important thing to understand."

