CHAPTER 4

Neurotoxins Influence Neurodevelopment: Organophosphorus and Carbamate Pesticides

But the plague of locusts proved as certain as the seasons. All that grew above ground, with the exception of the wild grass, it would pounce upon and destroy; the grass it left untouched because it had grown here ere time was and *without the aid of man's hand*. . . . A garment might be laid out on the ground to dry—a swarm would light on it, and in a moment only shreds would be left. —O. E. Rolvaag, *Giants in the Earth*

> It is not my contention that chemical insecticides must never be used. I do contend that we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm. We have subjected enormous numbers of people to contact with these poisons without their consent and without their knowledge. . . . I contend, furthermore, that we have allowed these chemicals to be used with little or no advance investigation of their effect on the soil, water, wildlife, and man himself. Future generations are unlikely to condone our lack of prudent concern for the integrity of the natural world that supports all life. —Rachel Carson, *Silent Spring*

An ample, economically profitable, and safe food supply is the goal of pesticide use on food. Pesticides have been used in western European civilizations at least since the Roman empire. The Romans used sulfur on crops, and plant extracts were sometimes used as well. By the seventeenth century, tobacco was discovered to be an exceptional insecticide. Now it is known that nicotine is the active ingredient that makes tobacco an insect killer.[1]

In the United States there are more than 20,000 household pesticide products with more than 300 active ingredients.[2] Most Americans have pesticides of some sort in their homes. Look under your sink, in the bathroom cupboard,

and in your basement, garage, or storage shed. Also look at your dog or cat. Flea and tick collars and flea soaps are insecticides. How many different kinds of pesticides do you have, how often do you use them, and how safe are they? What about pesticides in the foods you eat, water you drink, and air you breathe?

In this chapter I focus on two widely used categories of insecticides, organophosphorus (OP) and carbamates. These two categories of insecticides are similar to each other in their biological mechanisms. OPs and carbamates decay rapidly outdoors in the sun and do not bioaccumulate up the food chain. These features make them an improvement in some ways over organochlorine pesticides such as DDT. By focusing on these two categories, I do not intend to imply anything about their relative safety compared to pyrethrins, another major class of pesticides currently in use in the United States, or banned organochlorines.

We have already encountered one example of pesticide use gone awry. The Iraqi methylmercury poisoning described in Chapter 2 was caused by methylmercury applied as a fungicide on seed grain. It caused deaths and illness in adults who mistakenly ate the grain, and developmental delays in children who were prenatally exposed.

Pesticide misuses are still a problem. For instance, I play clarinet in the Madison Municipal Band. Before one of our summer concerts in a park near Madison, the park superintendent got over-zealous with the mosquito spray. A brass player ended up in the hospital with insecticide poisoning symptoms. No mosquito bites though! In Chapter 8 I explain how to protect against pesticide misuse. I also give some advice on how to reduce your overall pesticide exposure.

Research on how synthetic chemical pesticides affect children's neurobehavioral development is in its infancy. Here is an analogy to the history of lead. Until the mid-1940s, when Byers and Lord did their follow-up study of childhood lead poisoning victims, it was assumed that lead poisoning in children was only an acute illness. When the U.S. government provided money for lead exposure screening, researchers such as Needleman, Perino and Ernhart, and others began to find that IQ test scores were lowered by subtoxic lead exposure. The first studies were not long-term prospective studies. They simply measured lead and IQ test scores in children in a particular age group. After those initial studies showed that subpoisoning lead was tied to lower IQ and school performance, then long-term prospective studies were begun. Those studies tracked children's lead exposure and behavioral measures from birth all the way to adolescence.

Where are we now in the study of pesticides and children's behavioral development? Studies testing whether exposures early in life (prenatally or during infancy) relate to children's later behavioral functioning were just started in the late 1990s. Even though the potential for pesticides to harm