

## **Indiscriminately From the Skies**

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*Addressing Questions 1-3 and 6*

### *Introduction*

The 20<sup>th</sup> century brought with it the advent of modern chemistry; World War II bred the apparently insatiable desire for chemicals that kill. In this race to synthesize the deadliest weapon, there was one shining star that promised to bring life instead of death to the desperate soldiers on the front – Dichlorodiphenyltrichloroethane (DDT). This small molecule, a member of the chlorinated hydrocarbon family, possessed the amazing qualities that it was both extremely toxic to insects, yet for all intents and purposes posed no immediate health threat to man. Since then, DDT has fallen out of favor with some countries and institutions for various reasons, including environmental concerns and possible long term human effects such as cancer. Despite the changing attitude of world leaders towards DDT, the one constant is the complete control of developed countries over the use of DDT in the developing world.

### *Background*

DDT was discovered first in 1873 by a German student, Othmar Zeidler, but no use was found for it and he quickly moved on. It was rediscovered in 1939 by Paul Herman Müller during his search for the insecticide magic bullet. This virtually odorless, long lasting, highly effective and wide-reaching insecticide, which showed no immediate signs of mammal or plant health risk, met all of Müller's criteria for the perfect pesticide. After brief agricultural trials in Switzerland and the United States in the early 1940's, DDT met with fame when an outbreak of the louse-borne disease typhus promised to kill thousand of civilians and soldiers in Naples, Italy. The typhus outbreak was halted when DDT was employed to delouse the city in January of 1944. In the following years DDT was used widely in the South Pacific to control malaria and other insect born diseases for the troops in those regions.<sup>1</sup>

Following the war, DDT became a staple not only in malaria control programs throughout the world, but was used heavily for agriculture and pest management in developed nations. DDT production in the United States alone reached 3,000,000 lbs. per

month by 1946. One enthusiastic writer in the introduction to his 1946 book *DDT and the Insecticide Problem* declared that “it [is] clear that DDT is here to stay. What follows will, it is believed, make it equally clear that DDT will soon be recognized as our principle insecticide.”<sup>2</sup> This optimism was indicative of the whole world. Malaria cases, previously counted in the tens of millions, by 1960 could be counted in the hundreds.

Vector control accounted for a small fraction of the DDT being used world wide. The majority was being used as an agricultural, urban, or forest insecticide. Quantities ranging from 0.5 to 5 lbs per acre were regularly spread over thousands of acres. Aside from specific insects that DDT did not affect, such as aphids, DDT had wide success in controlling the pest populations of the world. Titles of articles published in the early 1940’s included “White Magic,” “The Conquest of Typhus,” “Gipsy moth wiped out,” “Very bad news for bugs,” “DDT a new weapon in the war against the insect enemies of mankind,” “Scientists view gun that won battle behind the lines in Italy.”<sup>3</sup> DDT was being included in such household items as paint, floor wax, and soap.

Despite the excitement, however, reports of ecological and human harm caused by DDT were published even before the beginning of mass use. From 1944 alone the following articles were published: “Over-effective insecticide,” “DDT not universal insecticide,” “DDT toxic to animals,” “DDT found highly toxic to fish and frogs,” “No joy in insect-free world,” “DDT poisonous to honey bees,” “Toxicity and potential dangers of aerosols, mists and dusting powders containing DDT,” “Toxic effects of DDT in man,” and “Insect war may backfire.”<sup>4</sup> Even DDT advocates, such as the one quoted above, indicated tests which showed almost complete destruction of fish populations in treated areas, bird losses, mild symptoms of nerve problems in people, and the disruption of natural predator controls through indiscriminate aerial spraying.<sup>5</sup> These concerns, however, seemed to have little affect on the public’s opinion of DDT. Aerial spraying programs continued well in to the 1960’s

### *Changing Times, Changing Regulations*

The public opinion of DDT in the developed world changed drastically during the 1960’s. Large spraying campaigns not only for agricultural purposes, but with the goal of eradicating invasive pests such as the gypsy moth and the Japanese beetle had lead to

large fish kills and a surprising reduction in birds.<sup>6</sup> Most people consider the turning point of the DDT debate to have occurred in 1962 when Rachel Carson published her book, *Silent Spring*.<sup>7</sup> The book compiled hundreds of studies regarding pesticides, including DDT, into a compelling written and entirely frightening account of the state of nature (interestingly, several of the studies she cited were also referred to in the 1946 pro-DDT book previously mentioned, *DDT and the Insect Problem*). Carson's book united three primary groups of people in the fight against DDT and insecticides:

Environmentalists (a quickly growing segment of the population with the advent of the Sierra Club and loosely including wranglers and hunters), people concerned about chemicals in the human environment (which Carson emphasized could be the equivalents of nuclear radiation), and women, who have been the primary protectors of the home and future generations threatened by a poisoned environment.<sup>8</sup>

United in favor of DDT, not surprisingly, were the chemical companies who manufactured DDT (Allied Chemical, Diamond Shamrock, Olin Mattiesen, Lebanon, Monsanto, and Montrose Chemical Corp. in the US), along with the Department of Agriculture. Farmers fell on both sides of the argument. Notably, groups that were particularly concerned with the well-being of developing countries, such as the World Health Organization (WHO), and virtually all malaria infested nations still were strong supporters of DDT.

By 1969 Sweden and Denmark both banned DDT due to the discovery of residues in the milk of cows, and people, who had any exposure to the insecticide. Hungary banned its use as well. The state of Michigan also banned DDT within its borders in 1969 primarily motivated by public outcry regarding fish kills, including the economically important Coho salmon. Several other states followed suit.<sup>9</sup>

In the United States and other developed countries, the primary issues in the DDT debate during the 1960's and 70's involved wildlife and ecosystem damage; possible toxicity of DDT over long exposure periods; bioaccumulation in fats (resulting in residues in milk) and persistence; but also the recognition of a need for effective pesticides for agriculture. The success of the campaign to ban DDT production and use had much to do with the political times, both with the growing fear of carcinogens and the burgeoning environmental movement looking for a cause. In general, the science

behind the environmental arguments appeared more substantial by 1970 than the evidence for human harm.<sup>10</sup> The newly formed EPA held hearings in 1971 to decide if DDT should be banned nationally. The hearings ultimately concluded that DDT was not an immediate threat to health. This decision was reversed in 1972 and a full ban on DDT for use in the United States was implemented (except for emergency vector control purposes). This flip flop can be justified in two ways. The first is that the initial committee was biased towards the Pro-DDT side because members of the committee came from the United States Department of Agriculture (USDA), traditionally very pro-DDT. From this point of view, the change in opinion was a correction of an initial imbalance of experts weighted towards agriculture. The second way to view it is that the scientific process of the committee was overturned for the sake of public opinion. The truth lies somewhere in between and neither side had irrefutable evidence of their correctness.<sup>11,12</sup>

Although developing countries for the most part supported the continued use of DDT for malaria control, and were supported in this by WHO recommendations<sup>13</sup>, many were nonetheless forced to reduce their use. Developed countries, which provide large quantities of aid to the developing world, began to refuse to support countries with DDT programs and to refuse the importation of food stuffs with any DDT residue. Considering that without foreign aid, most could not afford their DDT based anti-malaria projects anyway, poor countries were forced to concede so as to continue to receive vital funds.

By the time DDT was banned by individual countries in the late 1960's and early 1970's, the vast majority of developed nations had already conquered malaria within their borders. This gave them the luxury to address environmental concerns and the possible long term human effects related to DDT. Developing nations, who were still living with the daily threat of Malaria, had entirely different issues in their cost-benefit analysis. The policies, however, were handed down "indiscriminately from the skies." Just as DDT dispersed from airplanes killed all insects, good or bad, developed nations inflicted DDT regulation without regard to the individual cost-benefit analysis of each situation.<sup>14</sup>

### *Recent International Regulation*

When DDT was found in the arctic, the scope of the DDT problem changed. This showed that every corner of Earth was contaminated, no matter where the chemical use originated. In 1989 Canada and Sweden instigated an intergovernmental task force to address the global implications of persistent and far spread chemicals in the environment. In the 1998 Aarhus Protocol drafted by the committee, DDT was classified along with 11 other compounds as a Persistent Organic Pollutant (POP). No Latin or Central American and very few African countries were included among the signatories.<sup>15</sup>

In 2001, 151 countries signed the Stockholm Convention on Persistent Organic Pollutants. The convention called for the universal ban of DDT, among other persistent pollutants, except in registered cases of vector control (this allowance was made because the WHO strongly objected to the treaty otherwise).<sup>16,17</sup>

Despite the allowance for vector control, the international treaties have virtually eliminated all producers of DDT. This means that despite the formalities, the practical truth is that DDT use for malaria control has drastically reduced and correspondingly malaria levels are back on the rise.

Over the last 30-40 years, nearly 800 papers per year have been published on some aspect of DDT, yet little consensus has been reached.<sup>18</sup> Papers have indicated increased DDT levels in mothers with preterm birth<sup>19</sup>; it has been shown to act as an endocrine disrupter in various animals but has yet to be well linked to any form of human cancer; DDT is clearly a nerve toxin<sup>20</sup>, but the levels of safe exposure are debatable for humans, especially when other factors are considered such as accumulation or reactions with solvents; DDT has also been shown to cause liver damage. The activist climate of the 1960's and 70's shifted the burden of proof to the chemical companies. For developed countries using DDT primarily as an agricultural insecticide, the proven environmental concerns combined with the suspected (though to this day not totally substantiated) human health risks were enough to warrant a ban on the substance under the precautionary principle. The banning of DDT in developed countries, however, resulted in the unwilling removal of DDT from developing and malaria ridden countries. These countries were not given an option and there is a compelling argument that, based solely on the number of human lives lost to malaria each year, it was not in their best interest.

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- <sup>1</sup> James C. Leary, William I Fishbein, and Lawrance C. Salter. *DDT and the Insect Problem* (1946) McGraw-Hill Book Company, New York.
- <sup>2</sup> Ibid
- <sup>3</sup> Division of U.S. Insecticide Investigation. *A list of publications on 2, 2-bis(parachlorophenyl)-1, 1, 1-trichloroethane (called DDT) List no.2, to Dec. 31 1944.* (1945)
- <sup>4</sup> Ibid
- <sup>5</sup> James C. Leary, William I Fishbein, and Lawrance C. Salter. *DDT and the Insect Problem* (1946) McGraw-Hill Book Company, New York.
- <sup>6</sup> MacGillivray, Alex. *Rachel Carson's Silent Spring.* (2004) The Barron's Educational Series, New York.
- <sup>7</sup> Carson, Rachel. *Silent Spring.* (1962) Houghton Mifflin Company, Boston.
- <sup>8</sup> MacGillivray, Alex. *Rachel Carson's Silent Spring.* (2004) The Barron's Educational Series, New York.
- <sup>9</sup> Ibid
- <sup>10</sup> Fiedler, Heidelore (Editor). *Persistent Organic Pollutants, The Handbook of Environmental Chemistry.* (2003) Springer-Verlag, New York.
- <sup>11</sup> MacGillivray, Alex. *Rachel Carson's Silent Spring.* (2004) The Barron's Educational Series, New York.
- <sup>12</sup> Dunlap, Thomas. *Science as a Guide in Regulating Technology: The Case of DDT in the United States.* *Social Studies of Science*, Vol.8, No.3 (Aug. 1978), 265-285
- <sup>13</sup> WHO Position on DDT Use in Disease Vector Control under the Stockholm Convention on Persistent Organic Pollutants. <http://www.paho.org/common/Display.asp?Lang=E&RecID=7145>
- <sup>14</sup> Wright, James. *DDT: It is Needed Against Malaria, but for the Whole Environment...* Smithsonian National Associates (1970)
- <sup>15</sup> Fiedler, Heidelore (Editor). *Persistent Organic Pollutants, The Handbook of Environmental Chemistry.* (2003) Springer-Verlag, New York.
- <sup>16</sup> WHO Position on DDT Use in Disease Vector Control under the Stockholm Convention on Persistent Organic Pollutants. <http://www.paho.org/common/Display.asp?Lang=E&RecID=7145>
- <sup>17</sup> The Stockholm Convention on Persistent Organic Pollutants. <http://www.pops.int>
- <sup>18</sup> Ibid
- <sup>19</sup> Matthew Longnecker, Mark Klebonoff, Haibo Zhou, and John Brock. *Association between maternal serum concentration of the DDT metabolite DDE and preterm and small-for-gestational-age babies at birth.* *The Lancet*, Vol. 358, No, 9276 (July 2001) 110-114
- <sup>20</sup> Fiedler, Heidelore (Editor). *Persistent Organic Pollutants, The Handbook of Environmental Chemistry.* (2003) Springer-Verlag, New York.