The Controversy Behind Dioxins

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HC 441: Willamette River Health
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June 1, 2004

Dioxins are a global pollutant. They are found all across the world in the air, the ground and even the water. They are particularly problematic because the sources of dioxins are as numerous as they are various. Historically, dioxins were contaminants in herbicides and pesticides used heavily in the Willamette Valley. They are found in industrial areas along the valley, and they are also produced and released inadvertently by medical and municipal incinerators and pulp mills. They come from both point and non-point sources, and like many other organochlorines, they can move from ground to air and air to water. Although their presence in the river, both in the sediments and the fish, is known, the question of whether or not they are currently having an effect on the river's inhabitants or even on the humans around the Willamette River Valley is still unknown. However, the studies of dioxins in the river continue because of the knowledge of their extreme toxicity to animals, and because the question of whether or not they harm humans is heavily debated.

There are two very opposite arguments concerning this controversy. The first is that dioxins are relatively harmless to humans at even high concentrations and the belief that dioxins are dangerous to humans is greatly exaggerated by the media. The other is that dioxins are most definitely the cause of many types of cancers, miscarriages and birth defects. Interestingly, both sides have much scientific evidence to support their claims and while there is a certain amount of truth to each, their evidence and the

motivations behind their arguments must be weighed carefully against each other to determine the truth about dioxins.

In the past, many thousands of Americans have been exposed unknowingly, and it has only become more of a problem in the present-day. People living in the Willamette Valley have been exposed to dioxins mainly because of the river and its pollution. Chemical workers who manufacture herbicides and those living near areas of herbicide use have been exposed to them for hours at a time. In Times Beach, Missouri, the streets were sprayed with oil containing the chemical as a means to control dust in the dirt roads, and finally many more humans have been exposed by eating contaminated fish.

In the Vietnam War, dioxins were in herbicide mixes used for chemical warfare. The dioxin-contaminated herbicide was called Agent Orange because it had an orange band around the drum in which it was contained. Because Vietnam was mostly a vast jungle, it was a dangerous and treacherous battlefield for our conventional armies, where guerilla warfare was prevalent. Agent Orange was sprayed by planes over these jungles to destroy them and create an easier battlefield for the US troops. As a result, these troops were greatly exposed to the dioxins in the herbicide. One of them in particular flew his helicopter through clouds of the herbicide daily. After the war, Paul Reutershan returned and discovered he had developed cancer in his colon, liver and abdomen. He announced on television, “I died in Vietnam, but I didn’t even know it.” He died just several months later, after founding the Agent Orange Victims International and claiming that his cancer was caused by exposure to Agent Orange in Vietnam. This began the controversy of whether or not veterans of the Vietnam War should be compensated for the health problems they were suffering as a result of Agent Orange, and initiated the

larger controversy of whether or not dioxins really had an effect on humans at certain concentrations.

With these stories of victims exposed to Agent Orange came the widespread belief that dioxins were the most dangerous chemicals that existed. This was in part because of the media's influence on the public. In Michael Gough's book *Dioxin, Agent Orange: The Facts*, he explains that the media's treatment of the toxicity of dioxins has created an unnecessary fear of the chemical: "…generalized fear of 'chemicals' causing grave health effects contributes to dioxin's notoriety…Citizens and public health officials tolerate other cancer-causing chemicals…with much less overt concern." Ronald E. Gots (M.D./Ph.D.) agrees: "[The Agent Orange story] presented an ever popular view of the military industrial complex conspiring to produce a highly toxic material, caring little about the health consequences to those in its destructive path" (Gots, 171). He continues, "The sheer emotionality of this issue highlights the personal interests and, at times, irrationality that pervades the discussion" (Gots, 175). Nevertheless, environmentalists and many scientists maintain that dioxins are the cause of many fatal diseases such as autoimmune diseases, lung cancer, breast cancer, liver cancer, lymphomas, multiple myeloma, and leukemia. While the media have been known to manipulate the truth throughout history, one cannot necessarily discount the science that supports the argument of the environmentalists and scientists who make this claim.

Many believe dioxins to be dangerous to humans because of the chemical properties of dioxins which cannot be debated or misinterpreted in the debate. Dioxins are a type of organochlorine, which means that they are hydrophobic and tend to remain in fatty substances, including the fat in humans and animals. It is also for this reason that

they are so prevalent in river sediments. Another property is that because they are organic compounds, they are very stable in the environment and in humans. They have very long half-lives and thus remain intact in the environment for very long periods of time. Their ability to bioaccumulate in the food web is of particular concern; it is well-known that the milk of a mother who has been exposed to dioxins and other organochlorines is rich with these compounds and are passed onto their children in greater quantities. Their reactivity is also a property of dioxins that cannot be debated. The chlorine atoms on dioxins contribute greatly to their carcinogenicity and it is thought that the more chlorinated a dioxin is, the more likely it is to cause cancer. By looking at these properties, it becomes clearer what a chemical can and cannot do. The question under debate is whether or not or to what extent these effects are taking place in humans and in the environment.

Those who claim dioxins are relatively harmless to humans focus on the difficulties of investigating this issue. Gough says, "I cannot overstate the difficulties inherent in designing and executing studies to produce hard and fast answers to questions about how dioxin or any other environmental pollutant affects humans" (Gough, 21). Those who believe dioxins to be harmless to humans make the claim that although animal tests show conclusive evidence of dioxin's toxicity to animals, it tells little of its danger to humans. Naturally, it is difficult to do controlled tests on humans simply because it is unethical. Also, because cancer and many of the other diseases thought to be caused by dioxins are also caused by many other factors including genetic background, personal habits such as smoking, and other effects of the environment on humans, it is hard to

place all of the blame on dioxins. It is for this reason that some people say the evidence that exists is "subject to different interpretations" (Gough, 21).

There have been several tragic instances that have nonetheless demonstrated the possible effect of dioxins on humans. In November of 1984, a chemical plant in Italy accidentally released very high levels of dioxins when one of its autoclaves exploded. The dioxin released was TCDD, which is currently considered the most potent dioxin by both sides of the controversy. The 736 people that lived in the most contaminated zone (Zone A) were immediately evacuated. Eventually, as the gaseous dioxin cooled it settled into the soils in Seveso. Approximately 400 to 20,000 mg of TCDD were found in the Seveso soils per acre, which was "hundreds to thousands of times higher than potential levels associated with Agent Orange in Vietnam and hundreds of thousands of times higher than the lower EPA water limits." (Gots, 178) Immediately, scientists and epidemiologists did studies to determine the effects of the dioxins on the people that were exposed. Many people developed an acne-like rash called chloracne, which is the only conclusive and direct result of dioxin exposure. However, there are a variety of other health problems and diseases reported by a study done on possible health effects of dioxins in Seveso; many more women developed diabetes and a decrease in the male to female ratio 15-20 years after the explosion was observed, suggesting that dioxins may also be an endocrine disrupter. Also, there were cardiovascular effects that were "possibly linked to both chemical exposure and stressful disaster experience" (Pesatori et al., 127). Ronald Gots says, "People, however, did not die, again suggesting a higher resistance to the most serious acute toxic effects of TCDD by comparison with the animals that were killed" (178).

While no one died immediately, long-term effects such as cancer and other diseases were expected and observed. According to Joe Thornton at the University of Oregon, "Analyses of cancer incidence and mortality in Seveso found that people in the dioxin-exposed zones had experienced increased risks of liver cancer, lymphomas, multiple myeloma, and leukemia; mortality from these immune cancers increased with the length of time a person resided in the area" (Thornton, 194). He also adds, "And two studies by the International Agency for Research on Cancer (IARC) found that exposure to dioxin-containing herbicides was associated with a 29 percent increase in cancer mortality in men and a two fold increase in women in a large international cohort of chemical and agricultural workers." (Thornton, 195)

Although there are many ways that one can interpret these results and the statistical data, one can observe the patterns that exist when looking at the many epidemiological and toxicological studies that have been done on people who have been heavily exposed to dioxins internationally. Generally, the pattern indicates that wherever high levels of exposure to dioxins occurs, there is a subsequent increase in the risk of the above-mentioned diseases, as the number of people who develop these diseases seems to increase. Nonetheless, the debate continues as scientists question the methods used in these studies in various ways. For example, some claim that the studies done on Vietnam veterans, inhabitants of Seveso, and workers of chemical plants that produce these chemicals sometimes estimated their exposure to dioxins, suggesting that their data was biased.

However, one thing is clear, and that is that dioxins, harmful or not, are building up and accumulating in human tissue. Again, this is known to happen simply because it

is a chemical property or characteristic of dioxins. This poses a problem for the future. Joe Thornton says,

> Because humans occupy a position at the top of the food chain, our own bodies have become the ultimate dumps for the products of the chemical economy. Analyses of human fat, mother's milk, blood, breath, semen, and urine demonstrate that absolutely everyone—not just people living near major pollution sources—now carries a "body burden" of toxic organochlorines in his or her tissues. (41)

According to Ronald Gots, they can be detected in our blood and fatty tissue at average levels of five to seven parts per trillion (ppt). However, he says, "At those levels of ppt we find thousands of chemicals in our bodies and environments, many of which at higher levels are toxic or carcinogenic in animals. Furthermore, they have been there for some time despite which our longevity increases and overall cancer rates improve" (173).

Clearly, although the issue of its carcinogenicity and toxicity to humans is still debated, the presence and accumulation of dioxins in humans is not. As humans who have been contaminated by dioxins reproduce, the overall body burden of dioxins in humans increases because as much as 60% of pollutants that have accumulated in the mother gets flushed out through the breast milk and into the baby. If the effects of dioxins on humans are not clear now, its increase in concentrations in humans from generation to generation will eventually make its effects known.

Although the controversy of the effect of dioxins on humans continues, the question of their effect on animals and plants is less so. It is well known that they are harmful to animals, plants and insects. The incident in Seveso, Italy killed many of the animals, both small and large in the contaminated area. Therefore even if it is proven without a doubt that they are not harmful to humans, it remains an environmentally hazardous compound. Thus, research continues on the existence and effect of dioxins

and many other organochlorines in the Willamette River and its inhabitants. (Thornton, 32, 35) Their existence in the river is of concern because the dioxins behave similarly in the river as they do in humans and animals. It gets stored in the sediments, where these hydrophobic compounds can escape hydrolysis by the water, and remain in the river for years and even decades. "Virtually all the TCDD released into the environment will remain there, in one place or another, more or less indefinitely" (Thornton, 24). Also, "TCDD accumulates in the tissues of fish to levels 159,000 times greater than that in the water in which the fish swims (a figure known as a bioconcentration factor)" (Thornton, 35). Just as in humans, the accumulation of dioxins in the river is both a reality and inevitability.

Although the levels of dioxins in the Willamette River may not currently be high enough to observe harmful effects on its inhabitants, the knowledge of their effects at high concentrations on wildlife and their known tendency to bioaccumulate in animal tissue should be considered reason enough to take steps to remove them from the river. As of now, most of the clean-up techniques for dioxins specialize in decontaminating soils and surfaces, which cannot be utilized in freshwater lakes and rivers. To decontaminate soils for instance, there is a technique called pyrolysis in which dioxins are broken down and destroyed by heat. It is very effective in lowering concentrations of dioxins in soils to less than 1 part per billion, but the heat would ultimately harm the inhabitants of the river due to thermal pollution. However, there is another method that may be safe for use on sediments. John A. Bumpus and Steven D. Aust have been studying *Phanerochaete chrysosporium*, a wood-rotting fungus. This fungus is of interest because it is "able to mineralize a number of environmentally persistent

organochlorides…" (Exner, 340). Fortunately, one of these is TCDD. Another advantage is that it is able to dechlorinate organic compounds; in most cases, dioxins increase in toxicity and carcinogenicity with the number of chlorine atoms attached to them.

While there may be new techniques under development to clean up the dioxins and other organochlorines from freshwater environments, the solution to the controversy of the effects that dioxins have on humans may not yet be within our reach. In the meantime, it is important to realize that science is not always objective, and to be skeptical about any evidence that is presented as proof that dioxins are or are not harmful to humans. Joe Thornton states, "Skepticism is a long-held virtue in science," and he defines it as the "stubborn reluctance to accept unsupported beliefs and assertions – the refusal to pretend that we know more than we do" (Thornton, 413). As more "scientific" evidence is produced by either of the extreme views, it should be viewed with skepticism, leaning only on facts that are indisputable, and also taking into account the many motives of those involved in the controversy.

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