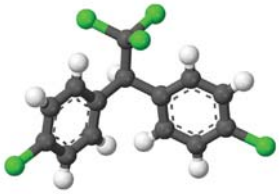

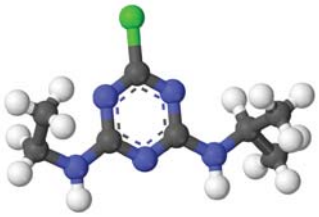

America's Pesticides

DDT (top) was America's poisnous pesticice for years. Atrazine (bottom) now replaces it.
http://upload.wikimedia.org/

Are we keeping the lid of Pandora's Box closed?

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From business to technological advances, we need government regulations to protect us from potential ills. The government is great for addressing market failures and enforcing rules that serve the public well being. But with the recent Chinese lead painted toy scare, we question if what the government does is sufficient. Furthermore, the government is fallible to lobbies; as Robert Kennedy Jr. remarks in Crime Against Nature, the businesses the government regulates directly work with the government. We are reassured of our safety by the various agencies that serve us, but are we really as sure about our safety as we think? Agrochemical industry is a great example of conflicts of interest in the role of the government with serious implications for our ecology, public health, and food supply.

Pesticides have revolutionized agriculture, yet some pesticides can pose a threat to our health. The infamous DDT began to raise health concerns in the 1940s, but it took another two decades before Rachael Carson's *Silent Spring* first called attention to the issue and another decade before DDT was completely banned in the United States. Pesticides have their benefits, no doubt. But their hazards are not immediately obvious, with diffused but serious health consequences.

One of the earlier popular pesticides, DDT was first used during WWII to control mosquitoes and lice that spread malaria and typhus and then became the most widely-used pesticide in the world (Daly et al. 1998, 279-300). The 1939 Nobel Prize in Physiology or Medicine was awarded to Paul Muller for discovery of this potent insecticide. Despite the benefits, DDT's usage was questioned by Rachel Carson in *Silent Spring*, which suggested that DDT and other pesticides may cause cancer and are hazardous to wildlife, especially birds by thinning their egg shells. The resulting public outcry catalyzed the growth of the environmental movement as well as the passage of bills to set up regulatory agencies and ban DDT.

We may think that our government, with its alphabet soup of agencies, FDA, EPA, USDA, has a watchful eye over the public's well being. Yet, UC Berkeley professor Tyrone Hayes has found another pesticide slipping between the cracks, and just as with DDT, animals in the wild have given us a warning about the toxicity of our chemicals. Hayes found that atrazine, one of the most widely applied pesticides of the last decade, has the potential to turn male frogs to female (Hayes 2007).

Atrazine is implicated as an endocrine disruptor. The EPA sets a level of 3 parts per billion (ppb) for drinking water, but Dr. Hayes has found that atrazine can be an endocrine disruptor at lower levels (Hayes 2004). It activates an enzyme which converts testosterone to estrogen (Sanderson 2000), and studies have found hermaphroditic frogs matured in water with concentrations as low as 0.1 ppb (Hayes 2002). Further highlighting the risks of pesticides, in the Salinas River, frogs found downstream of farmland where severe doses of pesticides are applied have weaker immune response to atrazine than

comparable frogs in the upstream, more pristine areas (Hayes 2007). The chemical challenge we have presented to such amphibians may have contributed to their overall global decline (Green 2003), but the effect of our pesticides is not limited to these animals.

What is concerning is that we share similarities with frogs and other vertebrates; we share the same hormones and similar systems. Atrazine affects all vertebrates, from fish (Moore 1998) and amphibians (Hayes 2002) to reptiles (Keller 2004) and lab rodents (Babic-Gojmerac 1989). With lower testosterone and higher estrogen levels, males affected by atrazine have reduced fertility, and immune function is also affected. Male rats treated with atrazine have significant drop in sperm count and sperm mobility as well as decreased body weight and marked physiological changes of their gonads (Kniewald 2000). As with DDT, these animal species' survival is adversely affected.

But what is more alarming is the ability of atrazine to cause cancer not only in the exposed organisms but also their offspring. Exposed mother rats produce male offspring with prostate diseases (Stoker 1998). It has even been shown that atrazine exposure causes neuronal damage in rats and mice (Rodriguez 2005). These studies have raised concerns about the level of atrazine found in nature.

Though we humans may seem a world apart from animals, we are part of the same world. Run-off from farms contaminates aquifers from which we draw drinking water (Aspelin 1994), and human health has been correlated with atrazine levels. Exposure to atrazine is associated with decreased sperm quality (Swan 2003) and with cancer in humans (Mills 1998). Though not with statistical significance, atrazine is found to correlate with prostate and other cancers (Rusiecki 2004).

Acting on precautionary principle, the Europeans have already banned atrazine in 2003 (Sass 2006). Despite this, the EPA has concluded that there is insufficient evidence to support the banning of atrazine (EPA 2003; Ackerman 2007). However, Hayes believes that the interests of the company have confounded scientific evidence (Hayes 2004). According to Hayes, the studies were poorly executed, with poor husbandry suspected of confounding the results. He notes that studies may have poor ability to ascertain the effects of atrazine because the control groups themselves were found to be contaminated, in one instance with the amount of atrazine exceeding the treatment dose by four fold. Dr. Hayes also found that possibly significant data were interpreted as negative results. Findings from Hayes's own lab were interpreted by the company to have no convincing evidence. He found that only studies funded by the agrochemical business claimed null effect while none of the other studies without conflict of interest agree with that assessment.

Atrazine affects all vertrebrates, from fish and amphibians to reptiles and lab rodents.

The company producing atrazine, Syngenta, has funded studies to show that its product has no effect on the environment and public health. Though a conflict of interest is blatantly obvious with these studies (Hayes 2004; EPA 2003), the EPA has continued to cite them as evidence for lack of scientific consensus and reason for inaction.

While the US continues to weigh the costs and benefits of using atrazine, the Europeans have banned it on their continent (Ackerman 2007). The Europeans had previously set a limit on the maximum amount of pesticide allowable in drinking water and banned atrazine after studies show that even appropriate use of atrazine will fail to meet the environmental limit (Ackerman 2007). In contrast, in the United States, cost-benefit analysis continues to weigh the values at risk, but Ackerman questions the wisdom of the analysis (Ackerman 2007). Significant damage will result if atrazine is as bad as leading critics claim, but the supposed loss of productivity by farmers without atrazine can be offset by commodity price increase or using a more effective though more expensive pesticide. He further claims that loss of profitability in atrazine-free "experiments" in Europe has yet to be materialized since Italy and Germany banned atrazine in 1991, and EU in 2005. In fact, Italy and Germany

outperform U.S. in yields and planted area and do not support the idea that atrazine is essential to corn agriculture. With EPA accused of violating ethics in talking with the companies that cloud scientific data (EPA 2003), the U.S.'s regulatory wisdom is in doubt.

Our government protects us through decisions made by regulatory agencies. Atrazine has been cautioned as a potential endocrine disruptor, shown to make hermaphroditic frogs and affect sterility of male rats and correlated with cancer. The Europeans have banned it because it cannot be safely used, while the U.S. debates on the cost and benefit to businesses and health. Though the two approaches reflect different values, the latter may be confounded by lobbying and conflict of interest. We may be persuaded by the presence of federal agencies into false sense of security, but we can remain vigilant and hold our government accountable to maintain the public trust.

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