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Introduction

Dramatic advances in chemical research and development during the 20th century have made it possible to synthesize molecules that were once unimaginable and that have never previously existed. Chemists have produced millions of unique chemicals. Tens of thousands of these are in commerce, and thousands are produced in excess of one million pounds annually. Inventories grow by several thousand new chemicals annually. With over $587 billion in global annual sales, and a projected increase of 85 percent in the next twenty years, this far-reaching industrial sector creates materials for myriad consumer products, pesticides, pharmaceuticals, and industrial manufacturing.[1]

The Extent of the Problem

Commercially successful chemicals usually do what they are intended to do, but many are unintentionally hazardous. Unfortunately, with the exception of pesticides and pharmaceuticals, the large majority of industrial chemicals in commerce today have never been fully studied for their toxicity to people or wildlife, despite widespread exposures.[2] This has been a source of trouble.

Sometimes chemicals act in surprising ways – either because their behavior is unpredictable or because no one has bothered to investigate their properties. In the 1960s, for example, scientists discovered that the insecticide dichloro-diphenyl-trichloroethane ("DDT") contaminated human breast milk throughout the world. It also turned up in Antarctic penguins, thousands of miles from where DDT was used. Now we know that the behavior of DDT is similar to other chemical compounds that are fat soluble, persistent in the environment, and bioaccumulate in the food web. Once loose in the world, these chemicals travel to the far reaches of all global ecosystems, contaminate most living things, and persist for decades or longer. Whatever toxic properties they have will be widely expressed.

Recent reports have identified similarly-behaving compounds in the blood of almost all newborn infants and adults. Examples of these compounds include brominated flame retardants and fluorinated chemicals used in Teflon and other non-stick, stain-resistant products. But persistent bioaccumulative compounds are not alone. Non-persistent but pervasive and continuously-used compounds such as plasticizers, organic metals, pesticides, solvents, and many others add to this complex cocktail with unknown hazardous properties.[3]

Available data show that individually some industrial chemicals alter gene expression; brain development; immune, reproductive, and endocrine systems; and can cause birth defects and cancer. Often, exposures in developing organisms (humans, wildlife, and laboratory animals) during critical windows of vulnerability can have permanent impacts at doses far lower than those necessary to cause health effects in adults. Some impacts are heritable and can be passed from generation to generation.[4]

Although it is certain that industrial chemicals contribute to disease and disability in the general population of humans and wildlife at current levels of exposure, the extent to which they are responsible for individual cases and disease patterns is often uncertain and vigorously debated. Some uncertainty results from the inherent complexity of biological organisms and the limits of science. However some uncertainty is plainly due to lack of good information, because chemical manufacturers often refuse to develop and provide it to the public.[5]

A Moral Responsibility

Our current political and common law legal systems presume that people and corporations are allowed to do whatever they want, within some contested constraints of safety and the rubric of cost-benefit analyses. In these systems, the burden of proof falls most often on people who raise safety concerns rather than promoters of technologies. Underlying these systems is also a presumption that economic growth, as measured by the gross domestic product, is always beneficial. These ideas were fully developed during the 19th century and continue to underpin our industrialized economy.[6]

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The world is now very different from what it was 150 years ago. Over six billion people inhabit the planet and mid-level projections anticipate nine billion within 50 years. Humans have altered planetary systems in fundamental ways. For example, climate, soil, water and air quality, fisheries,

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forests, pollinators, wetlands, coral reefs, and biological diversity are under severe stress. Industrial chemicals universally contaminate global ecosystems and their inhabitants with troubling but inadequately understood consequences. The reach of modern human technologies over great sweeps of time and space requires a re-evaluation of their ethical underpinnings.

In the United States and many other countries, dominant ethical frameworks that influence decision making are largely based on human rights and utilitarian cost-benefit analysis. The tension that sometimes develops between the rights of individuals and aggregate costs and benefits is resolved in political and judicial settings. However, several important ethical principles that are essential to human survival over the long term are missing. They include acting with a respect for living things, a realistic understanding of interconnectedness, an acknowledgement of the limits of the earth to assimilate human activity without becoming inhospitable to human existence, and moral responsibility. To be sure, all human activities and technologies should be subject to more extensive ethical screens, but the focus here is on chemical manufacturing and moral responsibility for safety testing.

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In common-law proceedings, parties may be held legally responsible for harm that they cause others, though even here costs and benefits are weighed. But the idea of moral responsibility either to take or refrain from some activity is different. Philosopher Hans Jonas argues that modern technology has introduced actions of such novel scale, objects, and consequences that the framework of former ethics can no longer contain them.[7] Jonas begins with the undeniable moral responsibility inherent in the parent-infant relationship.[8] Extrapolating from that starting point, Jonas then persuasively argues that, since future generations will exist, the power of our technologies to reach far into time and space is sufficient to establish a similar moral responsibility to future generations.[9] This is not an argument based on rights of future generations, but rather on our moral responsibility to them.

Much of our behavior suggests that we do not recognize responsibilities to future generations. We continue to draw down the earth's natural capital, squander resources into scarcity, and contaminate ecosystems with untested chemicals. We seem to be unable to recognize natural planetary limits and the need for restoration and regeneration. Optimists hold that recurrent damage and scarcity will forever drive us to invent our way successfully out of one crisis after another, but they are living in an imaginary 19th century world without limits.

Conclusion

Meeting a moral responsibility to future generations requires comprehensive attempts to try to understand the impacts of newly acquired powers. The chemical industry creates and disperses thousands of novel substances, many of which are known or likely to have biologic activity in humans and wildlife, with far-reaching consequences for human and ecological health. This technological prowess creates a moral responsibility to thoroughly test existing and newly developed chemicals for their safety before releasing them into the world. Some uncertainty will always remain, but it is precisely the scope and scale of technologies, coupled with uncertainty, that establish the moral responsibility for prospective, unbiased, comprehensive evaluation with future generations in mind.

Endnotes: Comprehensive Safety Testing of Industrial Chemicals

[1] Patricia L. Short, *Global Top 50*, Chemical & Engineering News, July 18, 2005, at 20-23, *available at* http://pubs.acs.org/cen/coverstory/83/8329globaltop50.html (last visited Mar. 10, 2006).

[2] Pesticides are regulated under the Federal Insecticide, Fungicide, Rodenticide Act and some pre-market safety assays are required. Pharmaceuticals are regulated by the U.S. Food and Drug Administration, and premarket testing and clinical trials are required. But the large majority of industrial chemicals are regulated under the Toxic Substances Control Act ("TSCA") administered by the U.S. Environmental Protection Agency ("EPA"). Although TSCA authorizes the administrator to require pre-market safety testing of newly proposed chemicals, formal rule making rarely occurs and must be balanced against costs and benefits. Many pre-TSCA, untested chemicals were simply allowed to remain in commerce when TSCA was adopted. Many of them remain in use today and have not undergone even screening safety assessment. *See* David Roe, Dr. William Pease, Karen Florini, & Dr. Ellen Silbergeld, *Toxic Ignorance*, *available at* http://www.healthy-communications.com/environmentaldefense.html (last visited Mar. 10, 2006).

[3] *See* Ctrs. for Disease Control and Prevention, Third National Report on Exposure to Environmental Chemicals, July, 2005, *available at* http://www.cdc.gov/exposurereport/3rd/ (last visited Mar. 10, 2006).

[4] Matthew D. Anway, Andrea S. Cupp, Mehmet Uzumcu, & Michael K. Skinner, *Epigenetic Transgenerational Actions of Endocrine Disruptors and Male Fertility,* Science, 308(5727), 2005 at 466.

[5] *See* Roe, *supra* note 2. It should also be noted that a voluntary chemical testing program negotiated between chemical manufacturers and the EPA has provided limited basic screening data for a small number of high volume chemicals, but has little prospect for providing any comprehensive data like, for example, neurodevelopmental toxicity testing. *See* EPA's Voluntary Children's Chemical Evaluation Program, *available at* http://www.epa.gov/chemrtk/vccep/index.htm (last visited Mar. 10, 2006).

[6] J. Guth, *Transforming American Law to Promote Preservation of the Earth*, The Networker, V.11-12 (Mar. 2006), *available at* http://www.sehn.org/Volume_11-2.html (last visited Mar. 29, 2006).

[7] *See* Hans Jonas, The Imperative of Responsibility: In Search of An Ethics for the Technological Age (Univ. of Chicago Press 1984).

[8] *See* Jonas, *id.*

[9] *See* Jonas, *id.*