



Public Understanding of Chemistry: Chemistry and its social-political-economic contexts continue to change.

Chemistry and chemistry-based technology that impact our lives make for the complexity and controversy of life and set the stage for thinking about public understanding of chemistry. The Public Understanding of Chemistry section will try to address chemistry in real life context with original contributions (articles/position papers/policy briefs) and/or published articles and columns in reputable sources (used with permission).

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CHEMICAL RISK AND THE PUBLIC PERCEPTION

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Introduction

There was a time not too many years ago when the public held science and scientists in undisputed esteem. Chemists, physicists, and medical researchers were respected by the public for their objectivity in the pursuit of their research by scientific methods. This objectivity was taught to students as early as junior high school. Students took pride in their pursuit of scientific studies. Chemical companies took pride in their activities--DuPont's motto was "Better things for better living-through chemistry". Chemical companies called themselves chemical companies, but today, many of the major chemical companies no longer have the word "chemical" in their name. These include such giants as the Monsanto Corp. and Union Carbide Corp. DuPont never had "chemical" as part of its name but dropped the chemistry motto some years ago. Chemistry had become a dirty word. What happened?

Part of the chemical industry's history is that it had operated in an unregulated era, when chemical companies, like everyone else, took advantage of the most economical and legal means of disposing of waste. It was burned, buried or sewered just like any other waste product; it was treated as garbage. Chemical waste was hauled away for \$4 per drum. The hauler often brought the chemical waste to an industrial dumpsite where drums and barrels of waste chemicals were unloaded and heaped onto a continuous fire. The empty, used containers were then sold and everyone was happy. It was not unusual for companies discarding chemical waste to insist that the carter assume all responsibility for the waste once his truck left the company's premises.

Changing Times

About 25 years ago, though, things began to change. As a result of a growing concern about our environment, the Federal Government established the Environmental Protection Agency. Many states established their own EPA or departments of environmental protection. Commercial practices of the past that admittedly were not in the best interest of a clean environment were now the subject of legislation. This legislation was much needed, and as responsible citizens we support it.

As a result, the word "hazardous" crept into our vocabulary as "hazardous waste" or "hazardous chemicals". We learned of PCBs, dioxins, and other carcinogens. The media--the press and television--in their zeal as investigative reporters, while exposing all the bad guys, at the same time, were exploiting the ignorance of the general population thereby creating a mood of hysteria. They publicized reports of impurities present at levels of several parts per *billion*; levels which are insignificant and harmless, as though they were present in hazardous amounts. Our ability to measure impurities at these low levels created the situation.

Recent hysteria was fanned by some of the publicity given to the Natural Resources Defense Council, whose name has appeared in the press recently in connection with Alar, a trade name for diuron, the growth regulator applied to apples (erroneously called a pesticide in most news articles). It was also deemed to be somehow, somewhat carcinogenic. The *New York Times*, on April 29, 1989 reported on page 1 that "Fears of Pesticides Threaten The American Way of Farming." The *Times* reported further that "Apple sales have dropped since the New York-based Natural Resources Defense Council (NRDC) published a report that said Alar, a chemical used to make apples crisp by controlling their ripening was carcinogenic and especially hazardous to children."

Now, what are the facts?

According to Prof. Thomas Jukes at Berkeley, an award-winning cancer researcher and a consultant to the California state advisory committee on cancer, the carcinogenicity index of the average daily intake of Alar, as measured on rodents, is 30 times smaller than 1 oz. of peanut butter, 30 times smaller than one slice of bread, and 2,800 times less than 12 oz. of beer; it is equal to that of 1 liter of chlorinated tap water.

The heads of three federal agencies also disagreed with the NRDC report and said apples are safe to eat, but their comments came too late to halt the decline in sales.

The *Times* article continued with this comment: "Fearful of the potential health perils and skeptical of chemical industry assurances of safety, consumers, says the *Times* are demanding a new quality control standard for fresh and processed products by insisting on food without any detectable pesticide residues." The article concluded with a statement by Daniel A. Botts, an official with the Florida Fruit and Vegetable Association, an Industry Trade Group in Orlando. He said, "We're being asked to reach a nonattainable and unnecessary standard of zero pesticide residues in food."

It was noted according to a recent study by the National Center for Policy Analysis of Dallas, and others, that when regulatory agencies ban products, the public often turns to other products that are even less safe.

Carcinogens Everywhere

"About one-half of all the natural and man-made chemicals that have been tested will produce cancer in rats and mice if administered in sufficiently large doses," says Richard Stroup, a Montana State University economist who coauthored the study. As a result, "When the government bans a carcinogenic chemical", he continued "there is a 50-50 chance that the substitute chemical people use will also be carcinogenic." For example, the study points out, a government ban on ethylene dibromide has removed the safest and most effective way of combating the far more dangerous carcinogen, aflatoxin, which is now infecting much of the nation's grain crop.

The International Agency for Research on Cancer, part of the World Health Organization, evaluated the carcinogenic risk of chemicals to humans, and reported them in a series of monographs. Of two groups, the so-called 2B group exhibited a lower degree of evidence of carcinogenicity in humans than the 2A group, the group

where there was a higher degree of evidence. Aflatoxin is listed in the 2A group. Ethylene dibromide, and incidentally both polychlorinated biphenyls and tetra-chloro dibenzopara-dioxin (commonly mis-named dioxin), are all in the 2B group, the one with the lower degree of evidence.

I should note that there was a refreshing exception to the media's general inability to assess risk in the editorial position taken recently by *The New York Times*, advocating operation of the Shoreham Nuclear plant on Long Island. The *Times* noted that the flip side of dismantling Shoreham was: (1) a CO₂ buildup in the atmosphere caused by burning oil in a new plant that would have to be built, (2) acceleration of the depletion rate of oil reserves, and (3) exacerbation of the "acid rain" problem. And, in addition, asks the *Times*, who is going to pay for the trashing of the five billion dollar plant? And where will the energy of the future come from? I might add that the same people, who distrust technology, look to future scientists to perform magic with the winds and the tides as economical sources of energy. However, we can be optimistic that solar energy could begin to be economically viable for some small part of energy requirements by the mid-1990s.

Another example of the public's inability to assess risk sensibly is the massive waste disposal problem-not industrial waste, but household waste. The choices at present are burial at sea or burial in landfills. As these reach their capacity, incinerators become the major remaining option, but N.Y.C. will bank the 2M odd remaining building incinerators in the next four years. Recycling a portion of the waste is possible, but its potential is overestimated by those opposed to incinerators.

In all these examples, the assumption is that zero risk is a serious option in the real world. Yet everyone knows that we take risks in everyday life by climbing a ladder at home, by stepping into a bathtub, by crossing the street, by driving a car or riding in an airplane. Yet our legislators, who view re-election as a major goal, will advocate risk-free environment, as if it were a serious option. Suffolk County on Long Island was so emotionally charged by the prospect of an operating nuclear energy plant at Shoreham, that no legislator, Republican or Democrat, Liberal or Conservative would dare be Shoreham's proponent. The voices of technology and science that seriously assess relative risks, were drowned out.

Now, why am I reciting all this to you, most of which you probably already know? As award-winning students, as leaders of the future, you have a responsibility to be sure you are heard, loud and clear. Scientists can, and often do disagree, but we cannot allow the media, or an anti-science segment in our population to substitute emotion, fear, or hysteria for fact. You have to be the voice that will explain things to the non-science public. There will be opportunities in social situations, in your community, and even politically to add your voices. As chemists and scientists you can help bring reason and balance to public opinion and restore the respect and esteem that science deserves. You have an important task ahead. Let me wish you success.

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