CHEMICAL FOOD SAFETY

A Scientist's Perspective

Jim Riviere, D.V.M., Ph.D.
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To Nancy,
Whose love makes it worth living!
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Acknowledgements

This work is a revised and expanded version of my original book on this subject: *Why Our Food is Safer Through Science: Fallacies of the Chemical Threat*, published in 1997. The lion’s share of thanks for both works must go to Dr. Nancy Ann Monteiro (my spouse, soul mate, and fellow toxicologist) for truly helping me write these books and otherwise putting up with me while I did it. Her insights, honest criticisms, and suggestions for topics and approaches remain indispensable. I thank our children, Christopher, Brian, and Jessica, for being there and tolerating lost time together. I especially thank our youngest, Jessica, for adopting a diet that forced me to look into this issue.

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Introduction

This is a book about the potential danger of pesticide residues in our food and how science can be applied to make these risk assessments. It is on the practical application of science to chemical food safety. I originally tackled this topic in 1997, in the predecessor to this book: Why Our Food is Safer Through Science: Fallacies of the Chemical Threat. Writing this book opened my eyes to numerous fallacies of the public perception of risk assessment and of their intolerance to certain types of risks, no matter how remote. As this book was being revised, the tragic events of September 11 unfolded, along with the new threat of bioterrorism as anthrax was detected in letters to news organizations and government officials. This author was involved in debriefing some government officials since my research has been focused for many years on military chemicals. As will become evident throughout this book, my other professional focus is on chemical food safety. I never expected that these two endeavors would merge into a sole concern. In fact, in the first incarnation of this book, I made the argument that these chemicals, used in military warfare, are truly “toxic” and would deserve attention if one were ever exposed to them. I had considered, but never believed, that they could actually be a potential for their use against American citizens. I have added a chapter on this topic as it further illustrates how “real risks” should be differentiated from the many “phantom risks” presented in this book. The phobia against chemicals and infectious diseases, rampant in the American populace, unfortunately greatly plays into the terrorist’s hands because panic magnifies small incidents of exposure to epidemic proportions.

I still cannot believe that many of the points on chemophobia and risk assessment present in the 1997 book still need to be addressed! A sampling of
the following headlines attests to the media confusion that is present, regarding whether the health of modern society is improving or deteriorating.

<table>
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<th>Improving?</th>
<th>or</th>
<th>Deteriorating?</th>
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<tr>
<td>Odds of Old Age Are Better than Ever</td>
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<td>Herbicides on Crops Pose Risk</td>
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<tr>
<td>U.S. Posts Record Gain in Life Expectancy</td>
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<td>Chemicals Tinker with Sexuality</td>
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<tr>
<td>Kids Who Shun Veggies Risk Ill Health Later</td>
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<td>Pesticides Found in Baby Foods</td>
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<tr>
<td>Americans Eat Better, Live Longer EPA Reports Little Risk to Butterfly from Biotech Corn</td>
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<td>Biotech Corn Found in Taco Shells</td>
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<td></td>
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<td>Monarch Butterfly Doomed from Biotech Crop</td>
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What is going on here? Should we be satisfied and continue current practices or be concerned and demand change through political or legal action?

These stories report isolated studies that if closely compared suggest that diametrically opposed events are occurring in society. Some stories suggest we are living longer because of modern healthcare, technology, and increased consumption of a healthy food supply. Others express serious concern for our food supply and environment and indicate something might need to be corrected before disastrous outcomes befall us all.

What is the truth? I strongly believe that the evidence is firmly in the court of the positive stories. I especially believe the data that prove eating a diet rich in vegetables and fruits is one of the healthiest behaviors to adopt if one wants to minimize the risk of many diseases.

These conflicting headlines strike at the heart of my professional and personal life. I am a practicing scientist, veterinarian, and professor working in a public land-grant university. My field of expertise can be broadly defined as toxicology and pharmacology. I am “Board Certified” in Toxicology by the Academy of Toxicological Sciences. To further clear the air, I am not financially supported by any chemical manufacturing company. The bulk of my research is funded from federal research grants. I have worked and published on chemical factors that may impact the Gulf War illness and on the absorption of pesticides and environmental contaminants applied in complex chemical mixtures. I have been involved for twenty years with an outreach/extension program aimed at avoiding drug and chemical residues in milk and meat.

I have always felt comfortable in the knowledge that the basic premises underlying my discipline are widely accepted and generally judged valid by my colleagues and other experts working and teaching in this area. These fundamentals are sound and have not really changed in the last three decades.
When applied to medicine, they have been responsible for development of most of the “wonder drugs” that have eliminated many diseases that have scourged and ravaged humanity for millennia. Yet even in these incidences, some serious side effects have occurred, and formerly irradicated diseases are making their presence felt.

I am also the father of three children and, like all parents, have their welfare in mind. Thus I am concerned with their diet and its possible effects on their long-term health. I am both a generator and consumer of food safety data. In fact, I originally started down this trail when the “father” in me watched a television news magazine on food safety and the dangers of pesticides in our produce. The program also highlighted the apparent dangers of biotechnology. This program was far from being unique on this topic, and similar ones continue to be aired even to this day. However, the “scientist” in me revolted when almost everything presented was either taken out of context, grossly misinterpreted, or was blatantly wrong.

This revelation prompted me to look further into the popular writings on this issue. I became alarmed at the antitechnology slant of much of the media coverage concerning food safety. As a result, I wrote an essay that was published in *Newsweek*. The comments I received convinced me that a book was needed to reinforce to the public that our food is healthier and safer than ever before in history. This article and the television program that prompted it occurred in early 1994. The headlines quoted above appeared in 1995 and some in 2000! Obviously the problem of misinformation is still present, and there is no indication that it will abate. Two books published in 2001, *It Ain’t Necessarily So* by David Murray, Joel Schwartz and S. Robert Lichter as well as *Damned Lies and Statistics* by Joel Best, continue to illustrate that many of the problems presented in this book are relevant and must be addressed as we encounter new challenges.

I remain concerned that “chemophobia” is rampant and the scientific infrastructure that resulted in our historically unprecedented, disease-free society may be inadvertently restructured to protect a few individuals from a theoretical and unrealistic risk or even fear of getting cancer. Also, I am concerned because our government has funded what should be definitive studies to allay these fears, yet these studies and their findings are ignored!

The most troublesome discovery from my venture into the popular writings of toxicology and risk assessment is an underlying assumption that permeates these books and articles, that the trained experts are often wrong and have vested interests in maintaining the *status quo*. Instead of supporting positions with data and scientifically controlled studies, the current strategy of many is to attack by innuendo and anecdotes, and to imply guilt by association with past generations of unknown but apparently mistaken scientists. Past predictions are never checked against reality, much as the forecasts of the
former gurus of Wall Street are not held accountable when their rosy predictions missed the stock market tumble of the last year.

The overwhelming positive evidence of the increase in health and longevity of today’s citizens is ignored. Instead, speculative dangers and theoretical risks are discussed *ad nauseam*. The major problem with this distraction is that valuable time and resources are diverted from *real* medical issues that deserve attention.

In an ideal world, all scientists and so-called “expert witnesses” would subscribe to the “Objective Scientists Model” from the American College of Forensic Examiners, which states that:

Experts should conduct their examinations and consultations and render objective opinions regardless of who is paying their fee. Experts are only concerned with establishing the truth and are not advocates. Forensic Examiners, whether they work for the government or in the private sector, should be free from any pressure in making their opinion.

In such an ideal world, experts would state the truth when they know it and refrain from making opinions when there is insufficient data. This, of course, assumes that experts have the necessary credentials to even comment. As this book will show, we obviously do not live in an ideal world!

Why am I concerned enough about these issues to write this book? Because I do not want to live in a society where science is misused and my health is endangered because of chemophobia and an irrational fear of the unknown. While writing the original version of this book, Philip Howard’s *The Death of Common Sense: How Law is Suffocating America* was published. After reading it, I realized that as a practicing scientist, I have an obligation to make sure that the data I generate are not only scientifically correct but also not misinterpreted or misused to the detriment of the public. By being silent, one shares responsibility for the outcome. The two new books by Murray and Best, mentioned earlier, give more examples of how our public views risk assessment and, furthermore, how it is a scientist’s obligation to help educate the public on the use of scientific information in the arena of public policy.

There are numerous examples of how common sense is dead. Philip Howard quotes some interesting cases relating to chemical regulations gone awry that remain pertinent today. The most amusing, to his readers (but not the individuals affected), is the requirement that sand in a brick factory be treated as a hazardous chemical since it contains silica which is classified by our regulators as a poison. I am writing this book from the sandy Outer Banks of North Carolina where I am surrounded by this toxic substance! Should I avoid going to the beach? How did and do these regulations continue to get derailed? Whose job is it to put them back on track?
Similar absurdities abound everywhere. In my own university, because of concern for insurance liability, our photocopy machine was removed from an open hallway due to fire regulations and the fear of combustion! It is now located in a closed conference room and is inaccessible when meetings are in progress. Similarly, paper notices are prohibited from being posted in corridors for fear of fire. I guess I should feel comforted by the fact that the same prohibition was mentioned in Howard’s book in a school system where kindergarten classes were prohibited from posting their artwork. Do such regulations protect the safety of our children? A similar position is the view that pesticide residues in food, at the levels existing today, are actually harmful to human health. Some would argue that we should be worried about dying of cancer if we eat an apple with trace levels of a pesticide. This book will argue that this is a theoretical and nonsignificant risk. There are far more serious health problems that merit our attention and deserve our resources to eradicate.

I do credit myself with one small success in this regard. I was the member of my university’s Hazardous Material Committee some years ago when we were trying to establish transportation guidelines for moving “poisons” across campus. The intent of the regulations was to protect staff and students when “truly toxic” chemicals were being transported. We wanted to ensure that a student’s “backpack” did not become a “hazardous material transport container.” However, we soon discovered that just because a compound appeared on a list of hazardous materials, it does not mean that special precautions need to be established for its handling. The most poignant example was the regulation, which if followed to the “letter of the law” would have required the university to employ a state-certified pesticide expert to transport a can of the pesticide Raid® from the local supermarket to my laboratory. Let’s get real!

These overinterpretations cause serious problems because they dilute the impact of regulations designed to protect people from real hazards. If one is made to follow too many regulations for handling chemicals that present minimal risks, these precautions will become routine. Then when a truly hazardous chemical is handled, there is no way to heighten awareness and have the person exercise real caution. As will become obvious, there are hazards that need our attention, and these misdirected concerns channel our attention in the wrong direction. Everyone becomes confused. I have conducted research with many of the pesticides that will be discussed in this book. I have served on various advisory panels including some for the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA). Thus, I have some working knowledge of how these regulations come into being and are put into practice. I also unfortunately see how they can be misused.

In our laboratory, we routinely deal with “really” toxic chemicals including a number of very potent anticancer drugs, pesticides, and high doses of a
whole slew of other poisons including chemical warfare agents. I want to make sure that when a student or colleague works with one of these “truly hazardous” chemicals, that this real risk is not trivialized and additional precautions are followed that are not required when picking up a can of Raid®! This is the true “adverse effect” resulting from this overreaction to trivial chemical risks.

The letters to the editor that resulted from my original *Newsweek* essay and comments after the publication of the original version of this book only further support Philip Howard’s contention that “common sense is dead.” In one phrase of the essay, I implied that pesticides are harmless. The point of the article (and this book) was that they are essentially harmless at the low levels found in the diet. Responders took this phrase out of context and attacked! They suggested that what I wrote was biased because my laboratory must be “heavily supported” by the chemical industry. (However much I would wish, this is not true!) In any event, this should not be relevant because I take the above “Objective Scientist Model” seriously. Second, all research is supported by someone and thus biases due to the supporting agency/advocacy group or the individual scientist may always be present.

Another writer suggested that what I wrote could never be trusted because I am from the state of North Carolina and thus as a “Tarheel” must have a track record of lying in support of the safety of tobacco! This is a ludicrous argument even if I were a native Tarheel. My North Carolina friends and colleagues working in the Research Triangle Park at the National Institute of Environmental Health Science and the Environmental Protection Agency would surely be insulted if they knew that their state of residence were suddenly a factor affecting their scientific integrity! Such tactics of destroying the messenger are also highlighted in Murray’s book *It Ain’t Necessarily So*. Such attacks, which have nothing to do with the data presented, convinced me that I had an obligation to speak up and say, “Let’s get real!”

This book deals with the potential health consequences of pesticides, food additives, and drugs. All of these are chemicals. The sciences of toxicology, nutrition, and pharmacology revolve around the study of how such chemicals interact with our bodies. As will be demonstrated, the only factor which often puts a specific chemical under the umbrella of one of these disciplines is the source and dose of the chemical or the intent of its action. The science is the same in all three. This is often forgotten!

If scientists such as myself who know better keep quiet, then someone will legislate or litigate the pesticides off of my fruit and vegetables, making this essential food stuff too expensive or unattractive to eat or ship. They will remove chlorine from my drinking water for fear of a theoretical risk of cancer while increasing the real risk of waterborne diseases such as cholera. They will outlaw biotechnology, which is one of our best strategies for actually
reducing the use of synthetic chemicals on foods and generating more user-friendly drugs to cure diseases that presently devastate us (AIDS, cancer) and those which have yet to strike (e.g., the emerging nightmares such as Lassa fever and the Ebola virus and hantaviruses). By banning the use of pesticides and plastics in agriculture, our efficiency of food production will decrease which may result in the need to devote increased acreage to farming, thus further robbing our indigenous wild animal populations of valuable habitat. Our environment will suffer.

I have attempted to redirect the present book to those whose career may be in food safety, risk assessment, or toxicology because they are often unaware of how the science of these disciplines may be misinterpreted or misdirected. These issues are not covered in academic and scholarly textbooks. Conclusions published in the scientific literature may be misdirected to support positions that the data actually counter. This may often occur simply because the normal statement of scientific uncertainty (required to be stated when any conclusion is made in a scientific publication) is hijacked as the main findings of the study. These pitfalls must be brought to the attention of working scientists so conclusions from research studies can be crafted to avoid this pitfall.

The central thesis of this book is as follows: The evidence is clear that we have created a society that is healthier and lives longer than any other society in history. Why tinker with success? We have identified problems in the past and have corrected them. The past must stay in the past! One cannot continuously raise the specter of DDT when talking about today’s generation of pesticides. They are not related. If one does use this tactic, then one must live with the consequences of that action. When DDT usage was reduced in some developing countries because of fear of toxicity, actual deaths from malaria dramatically increased. DDT continues to be extensively used around the world with beneficial results.

This book is not about the effect of pesticide spills on ecology and our environment. These are separate issues! This book is about assessing the risk to human health created by low-level pesticide exposure. There are serious problems in the world that need our undivided attention. The theoretical risk of one in one million people dying from cancer due to eating an apple is not one of them, and continued attention to these “nonproblems” will hurt us all. In fact, using readily available data, one could calculate a much higher risk from not eating the apple since beneficial nutrients would be avoided! This is why I wrote this book.
Probability—The Language of Science and Change

There are lies, damned lies, and statistics.
(Benjamin Disraeli)

This book is written to refute the current public misconception that modern science and technology have created an unsafe food supply through widespread contamination with pesticides or unbridled biotechnology. Although mistakes may have been made in the past, most have been corrected long ago and cannot be continually dragged up and used to support arguments concerning the safety of today’s products. Eating fruits and vegetables is actually good for you, even if a very small percentage have low levels of pesticide residues present. The scarce resources available for research today should be directed to other issues of public health and not toward problems that do not exist. Most importantly, advocating the elimination of chemical residues in food while simultaneously attacking modern advances in biotechnology aimed at reducing this chemical usage are diametrically opposed causes. Both should not be championed by the same individual because the best hope for reducing the use of organic chemicals is through bioengineering!

The student entering the field of food science is often not aware of these societal biases against chemicals and biotechnology. The excitement of the underlying scientific breakthroughs in genomics and other fields is naturally applied to developing new food types that fully use the safer technologies that form the basis of these disciplines. Thus genes are manipulated in plants to
produce enzymes that prevent attack by pests without the need to apply potentially toxic chemicals. When these truly safer foods are brought to market, students are amazed to discover the animosity directed against them for using technology to manipulate food. It is this thought process that must be confronted.

The primary reason these issues attract such widespread attention is that modern Western society, especially in the United States, believes that science and technology are in control and disease should not occur. If anything goes wrong, someone must be to blame. There is no doubt we are living longer than ever before—a fact often conveniently ignored by many as it obviously does not support a doomsday scenario. Just ask any member of our burgeoning population of centenarians. As we successfully combat and treat the diseases that once killed our ancestors and grandparents at an earlier age, we will obviously live longer, and new disease syndromes will be encountered as we age. They will become our new cause of death. Yet since we believe that this shouldn’t happen, we must blame someone, and modern technology is often the focus of our well-intentioned but misplaced angst over our impending death. The reader must keep in mind that we all will die from something. It is the inevitable, if not obvious, final truth. The topic of this book is whether eating pesticides on treated fruits or vegetables has an effect on when and how this ultimate event will occur.

A major source of confusion in the media relates to how science tries to separate unavoidable death due to natural causes from avoidable death due to modern drugs or chemicals. This is the field of risk assessment and is a crucial function of our regulatory agencies. Confusion and unnecessary anxiety arise from the complexity of the underlying science, misinterpretation of the meaning of scientific results, and a lack of understanding of the basic principles of probability, statistics, and causal inference (assigning cause and effect to an event).

The principles to be discussed comprise the cornerstone of modern science, and their continuous application has resulted in many benefits of modern medicine that we all enjoy. Application of statistics to science and medicine has most likely contributed to the increased human lifespan observed in recent decades. However, more recently, it has also been responsible for much of the concern we have over adverse effects of modern chemicals and pesticides. Since all of the data to answer these issues are expressed as probabilities, using the language of statistics, what does using statistics really mean? How should results be interpreted?

Scientists are well aware that chance alone often may determine the fate of an experiment. Most members of the public also know how chance operates in their daily lives but fail to realize that the same principles apply to most scientific studies and form the core of the risk-assessment process. Modern sci-