CLIMATE CHANGE: THE FORK AT THE END OF NOW

Micha Tomkiewicz
If thou doest well, shalt thou not be accepted? And if thou does not well, sin lieth at the door. And unto thee shall be his desire, and thou shalt rule over him.

—Genesis 4:7

Any system in chemical equilibrium, as a result in the variation in one of the factors determining the equilibrium, undergoes a change such that, if this change had occurred by itself, it would have introduced a variation of the factor considered in the opposite direction.

—Henry Le Chatelier
To the three lovely anchors of my definition of “now”:
Justin, Samantha, and Jack
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Foreword

“It’s snowing again,” says my neighbor as we walk our dogs along the road, “and it’s been so cold for months.” I can see him sliding into a moment of comforting self-delusion. If there’s so much snow and cold this winter, then clearly there is no global warming going on. Right?

I don’t want to ruin our walk in the woods, but I can’t help mentioning the melting glaciers, the warming seas. And because he is a cordial man not given to argument, he nods that yes, there is that to think about. So we go our separate ways to our houses in the woods, with the smoke from our wood-burning fire places wafting picturesquely from our chimneys, and we think about how expensive this precious life is becoming. Our propane bills are huge, and gas is climbing toward $4 a gallon again. Such is life. For the foreseeable future, anyway.

I make a mental note to give my neighbor Micha Tomkiewicz’s book Climate Change: The Fork at the End of Now as soon as it is published. Prof. Tomkiewicz, Director of the Environmental Studies program at Brooklyn College, CUNY, has been telling students and colleagues for years just how long the foreseeable future, or what he calls “now,” really is. One hundred years. It’s an estimate, but a learned one, of how much time this “superspecies,” the human race, has before the earth runs out of recoverable fossil fuels to keep our cars and furnaces running. One could say that we are, on this pleasant, snowy day, complicit in sanctioning a future genocide by not paying attention.

Despite the compelling evidence that we are changing the planet in ways that may finally eliminate us from the system, Prof. Tomkiewicz remains hopeful. It’s not too late, he believes, if we act now. A massive environmental studies program needs to take place and the United States needs to assume a leadership position in launching that program. We now need not cowboys but shepherds, not isolationists but world partners to care for our home. We need to understand exactly what climate change means: what is causing it, what the consequences will be if we ignore it, and how we can ameliorate it so that the human race can, quite literally, go on living.

Written to be a textbook for his own course, Prof. Tomkiewicz’s work is an accessible and objective source to help all of us learn the science and responsibly join the public policy debate. The first half of the book provides a short, intense course on the physics and chemistry of climate change. Prof. Tomkiewicz gives us a working vocabulary of concepts and principles, and in boxes that accompany the narrative, he provides detailed explanations, formulas, diagrams, equations. What is the carbon cycle? What is energy? What is biomass? A reader with a basic knowledge of chemistry and physics can follow the explanations step by step, doing the math
to see exactly what is happening to the atoms and molecules of the atmosphere, to the water, the soil, the plants, the animals, as we burn fossil fuels, denude the forests, and manufacture cement, a product that is problematic not only when it is laid, but in its creation. He anticipates our questions and raises some we would never think to ask, and steadily a complex body of knowledge unfolds for us.

Climate change, Prof. Tomkiewicz explains, has always been part of the earth's history—long preceding the human race. And it will continue to occur. But for us to assume, then, that the changes now occurring are a natural part of those great cycles is to ignore the evidence that we have dramatically increased the pace and the magnitude of change in the last 50 years. “The rate of atmospheric buildup can [now] be measured in terms of years and not thousands of years” (page 52). The charts illustrate the dramatic changes that will begin at mid-century. We do have the collective intelligence and imagination to moderate that change, but we have to stop wasting time. We can’t rely on business as usual, counting on the notion that somehow, what he calls the “Just World Hypothesis” will sustain us and everything will be fine in the end. Everything will not be fine, never has been, and this latest and greatest challenge to our well-being will not go away for us unless we die tomorrow. But what will happen to our children and to theirs? We must direct our best selves to the challenge of “reestablishing an atmospheric equilibrium that we can live with” (page 109), and time is running out.

The second half of the book takes up the paths available to us. Prof. Tomkiewicz describes in precise detail the existing and proposed sources of alternative fuel and the costs involved in shifting from fossil fuels and nuclear fission, with their attendant dangers, toward other forms of energy that are sustainable and will not adversely affect the climate. Some of these have yet to be developed. But the catastrophic consequences of our pursuit of more of the same sources of fuel become harder to ignore. Consider the British Petroleum oil spill of the summer of 2010. We can learn to celebrate a landscape of windmill farms—those odd, long-stalked flowers turning against the sky, reminding us what an ingenious, adaptable, and wise species we can be.

The word “existentialism” has always meant a philosophy of mind to me. How do we make meaning in the world and in our lives in the face of a pressing “nothingness” that laps at our consciousness. To Prof. Tomkiewicz, the existential dilemma is literally about existence. How do we cast off our malaise, our greed, our short-sightedness to engage the most daunting problem the human race has ever faced: its ability to continue to exist.

One cannot read this book without being transformed by it. I want to give it to everyone I know. It can be turned to again and again as our desire to learn more deepens and as we consider how to be part of the solutions. It is a book composed with a vast knowledge of the
physical world and the global community, by a man who hangs on to his sense of humor, his hope, and his love for our stressed-out planet and its careless stewards. He models for us a way to love the earth with all the passion, gratitude, and precious care it deserves. As poet Mary Oliver puts it, “As for myself, I swung the door open. And there was the wordless, singing world. And I ran for my life.”

Geraldine DeLuca
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March 2011
Acknowledgments

The book might have started in the early 1990s when I was visiting the Hanford Nuclear Facility in Richland, Washington, as part of a joint project on nuclear waste disposal. The apparent communication difficulties between the technical staff and the surrounding communities was visible enough to convince me there is a serious collective hole in our educational system: We do not teach enough students to be intellectually “bilingual” to facilitate communication among scientists, engineers, and the general public directly affected by changes in the physical environment. C. P. Snow’s observation about the breakdown in communication between “The Two Cultures” is as valid today as it was in 1959. With that in mind, I went to the provost at my school—Brooklyn College of the City University of New York—with a suggestion for an environmental studies program to educate students to become “bilingual” in the physical and social sciences in the context of teaching awareness of pressing environmental issues. The provost, the president, and the faculty were very supportive and after about 5 years of collective efforts, the program was approved and is now successful.

At about the same time, the Earth Summit was convened in Rio de Janeiro, Brazil, to mark the start of the global realization (Chapter 13 in the book) that the ozone hole was not a singular global threat that requires immediate global response but a much more general threat, in the form of climate change on a human time scale, that requires immediate response. It was obvious already then (1992) that attempts to mediate the changes in atmospheric chemistry that result in climate change have to come through the political process. The response must involve fundamental changes in the ways that the world uses energy. The economic inequities in the world, which to a large degree were fueled through the supply of low-cost fossil fuels, require that the response will be differential. It is not enough that we change our energy sources to those that do not contribute to climate change. Changes must be done in a way that will let developing countries escape the poverty trap. For these changes to come through the political process, they require that all of us be able to make decisions based on our own analysis—no epistemological lawyers. This book started to take shape about 10 years ago with the idea of addressing these issues based on first principles.

Over the last 6 years, I have used drafts of various parts of the book to teach two general education courses at Brooklyn College: “Energy Use and Climate Change” in the upper-level general education program and a mandatory seminar for our Honors College students designed to provide some exposure to science. Both courses have no prerequisites.
Acknowledgments

This project would not have been possible without the support of many people. First, I would like to acknowledge the constant support of, and feedback from, the Brooklyn College students who took my courses. The students were not shy about providing comments ranging from trivial typos to a complete incomprehension of certain sections. I would like to give special thanks to Lea Ruggiero, who volunteered the first comprehensive editing of my manuscript (after finishing the course and getting her grade). She was working hard doing it until family reasons forced her to leave the college.

Special thanks to two friends, Prof. Geraldine Deluca, from the English department, and Ken Clark for going very carefully through relatively recent versions of the manuscript, sometimes going through the calculations and the data in the boxes, double-checking numbers, and highlighting any inconsistencies or obscure arguments they could find. They have spent countless hours immersing themselves in topics new to them and have been instrumental in providing me with a sense the effort is worthwhile. They also allowed me to test the accessibility of the ideas presented for a nontechnical audience.

During the time this book was in “incubation,” I spent quality time discussing various aspects with many colleagues. I would like to single out Profs. David Cahan and Reshef Tenne from the Weizmann Institute in Israel for the countless discussions on many of the issues addressed. I would like also to thank Ms. Fran Columbus for taking the manuscript and trying to help spread the word.

I would like to express my special thanks to the editorial team of Momentum Press under the leadership of Joel Stein for converting the manuscript into a book of which I am proud. Special thanks to Stan Wakefield, a literary agent who introduced me to Joel Stein and Momentum Press—great matchmaking.

Finally, special thanks to my wife, Louise Hainline. She is mentioned in the book as a source of inspiration on number of specific issues, but her greatest impact was in fortifying my perseverance to bring the effort to a successful conclusion.
Preface

Arnold Toynbee wrote that civilizations die from suicides, not murder.\(^1\) The predicted consequences of “business as usual” environmental scenarios over the next 70 years could be imprecise in some details and even slightly wrong in timing. Still, it is clear that once we pass a critical point in the ability of the planet to adapt to the accumulation of greenhouse gases in our atmosphere, the consequences amount to a global genocide—but a self-inflicted one. We know how to mitigate this possible future, but we need our collective will to do so. The top-down approach through the political system is facing many obstacles. The bottom-up approach through the educational system might provide badly needed assistance.

The main issues in this book are the climatic consequences of societal energy policies. The main thesis I subscribe to is that a decision about our future energy mix rests at the “bottom of the food chain” with likely direct impact on most other collective policy decisions that will be required in the near future. In terms of climatic consequences, the issue addressed is the necessity and practicality of shifting our energy use to energy sources that do not have climatic consequences. All fossil fuels emit carbon dioxide upon burning and thus have climatic consequences.

This book presents the case that the synergism between global anthropogenic (man-made) climatic changes, energy policy, and resource allocation on every level makes a holistic approach the most productive one. The data consists of energy use, population, and various wealth indicators. It requires collaboration among individuals with a broad range of expertise, as well as ordinary citizens who participate in the political process, and it requires all these groups somehow become “multilingual” enough to understand (if not agree with) the concerns and perspectives of those with different types of expertise and different points of view. The book describes how the information is collected, explores the underlying scientific principles, and uncovers the assumptions embedded in projected scenarios.

The general structure of the book is based on a dual presentation. The key data and the corresponding descriptions are presented in a continuous way without resorting to “tutorials” about the prerequisite science. The prerequisite science and some specific issues are presented in a series of inserts, or “boxes.” The inserts will be trivial to some and very demanding to others. They provide the foundation to the story. The science includes topics such as use and conversion of units; a short introduction to the language of chemistry with examples from the “chemistry of life,” which includes photosynthesis, respiration, and combustion of fossil fuels; and a brief introduction to energy and power with the anchored restrictions science puts on conversion of energy from one form to another. The boxes include a description of the chemistry of carbon dioxide in
the atmosphere and in water. A few boxes include interactive exercises that allow readers to calculate, from first principles, key global phenomena, such as the construction of a simple model to estimate the energy content of the Amazon forest and compare it with the energy we use; and calculate, again from first principles, the average global temperature and how much energy it takes to make rain. It is intended to be demanding of the reader but accessible and achievable for those committed to a deeper understanding of this globally critical problem.

This book was written to address the fundamental issue that in democratic societies, the decision-making process to address an existential issue such as man-made climate change is in our collective hands, and yet most of us need help with the fundamental scientific background to consider it in a rationally productive way. Collective choices come mostly through the political process. Political decisions affecting the future must be based on some ability to predict the future. Predicting the future on the time scale needed here is a very risky business. Here, I am trying to make an argument that we must discard the easy choice of relying only on “experts” to make predictions or learning from the experiences of others.

The basic premise—that anthropogenic changes to the atmosphere have major effects on the climate through changes of the solar energy balance—can withstand critical scrutiny. We fail to act upon this premise at our peril. But, the argument continues, the global warming issue is much too important to be left to scientists to decide on actions and remedies. Throughout the book, I have consistently described the required change in behavior as a “feeding transition”—namely, that the science is solid enough to initiate a global transition from very convenient fossil fuels to largely experimental nonfossil fuel sources. The majority of the world’s community agrees: the political process started with the Rio Declaration on Environment and Development, matured to implementation with the Kyoto Protocol, and got somewhat shaken with Copenhagen is a testimony to this sentiment.

The case is made throughout the book that although the issue of anthropogenic causality of climate change is a complex issue and encompasses vast domains of our intellectual, physical, moral, political, and economic world, it can and must be addressed. However, the observations from which we draw much of our understanding span an equally broad spectrum. Because many of the issues relate to rather long-range projections (“end of now”), the public discussion invites cherry picking—pursuing a certain agenda, choosing the evidence to support that agenda, and ignoring evidence that points in other directions. Such a process creates polarized positions that reinforce and feed on each other. This kind of dynamic reduces the issue to one of arbitration. Yet because climate change affects us all, it is very unlikely we will find an objective and informed judge who will act as a universally acceptable arbiter, and it is probably equally unlikely we collectively wish to search for one. What is left for us to do is to continue to rely on the political process to formulate policies, with the physical environment dispensing its canaries from time to time to warn us against drifts in the wrong direction.
About the Author

Micha Tomkiewicz is a professor of physics at Brooklyn College, City University of New York (CUNY), and professor of physics and chemistry at the Graduate Center of CUNY. He is also director of both the Environmental Studies Program and the Electrochemistry Institute at Brooklyn College, and he was divisional editor of the Journal of the Electrochemical Society. He has been a Broeklundian Professor at Brooklyn College, a fellow of the Japan Society for the Promotion of Science, and a Wolf fellow of the Weizmann Institute in Israel. He is the author or coauthor of over 140 scientific articles and has written numerous book chapters, review articles, edited books, and invited columns. He has concentrated recently on developing ways for nonscientists to understand the challenges and choices created by the process of climate change.