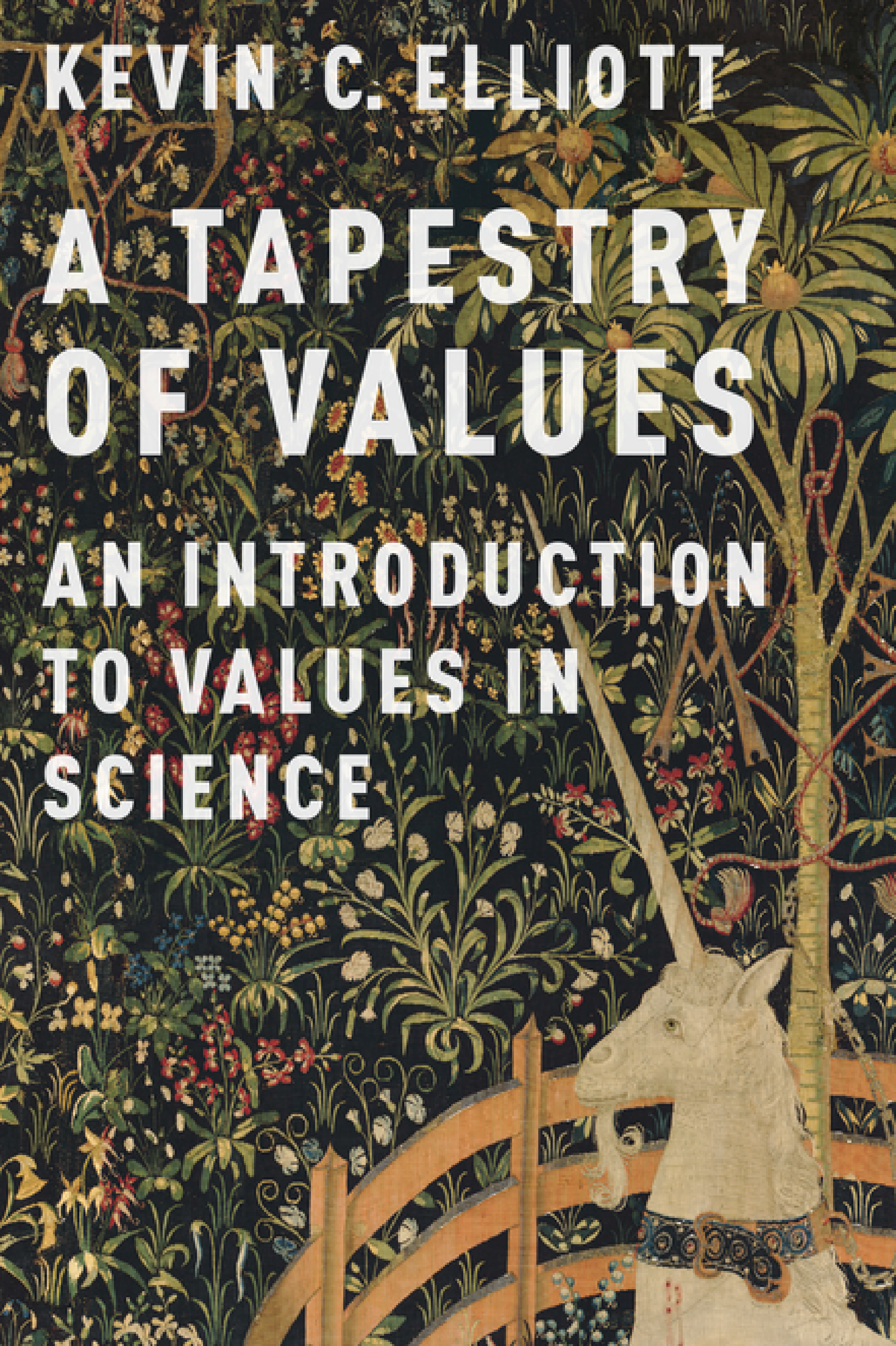
KEVIN C. ELLIOTT

A TAPESTRY OF VALUES

AN INTRODUCTION TO VALUES IN SCIENCE



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For my children, Jayden and Leah

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PREFACE

My motivation for writing this book stemmed from a gap I perceived in the literature on science and values. A host of recent books and articles have addressed this topic in one form or another. The fields of history and philosophy of science (HPS) and science and technology studies (STS) have focused a great deal of attention on the intersection of science and values. Moreover, semi-popular books like *Merchants of Doubt* (Oreskes and Conway 2010), *Doubt Is Their Product* (Michaels 2008), and *Bad Pharma* (Goldacre 2012) have made the wider public more aware of the ways that values influence science. Nevertheless, much of this literature suffers from two weaknesses. First, it sometimes emphasizes the general point that science is deeply influenced by values but without getting into nitty-gritty details about the precise ways in which values influence specific choices about scientific methods, concepts, assumptions, and questions. Second, it often highlights the presence of values in science without clearly exploring how to tell the differences between influences that are acceptable and those that are not.

The field of philosophy is well equipped to fill both these gaps. Philosophers of science have in fact written a good deal about both these issues—identifying the range of ways that values influence science and deciding which influences are appropriate and which are not. Unfortunately, most of this work has been written in the form of scholarly journal articles and technical books that are not accessible to a wide audience. My goal was to incorporate these philosophical insights into a book that a college freshman or an interested member of the general public could read and find to be helpful and informative. Also, while taking a philosophical perspective, I wanted the book to be sufficiently interdisciplinary to be appropriate for introductory courses on science policy, research ethics, history of science, environmental studies, and STS, as well as the philosophy of science. Finally, I wanted the book to be relevant to practicing scientists and policymakers.

With these goals in mind, I have written this book so that it focuses heavily on case studies of actual situations in which values have influenced scientific practice. In order to enhance the book's readability, I have also avoided using in-text citations and footnotes in favor of providing a list of sources after each chapter that can direct readers to the relevant references at the end of the book. While striving for readability, I have also maintained a philosophical stance that consistently asks whether and why particular value influences are justifiable. The book's chapters are organized around five different features of science that can be influenced by values: the choice of research topics (chapter 2), the manner in which a topic is studied (chapter 3), the aims of specific scientific investigations (chapter 4), the ways scientists respond to uncertainty (chapter 5), and the language employed for describing results (chapter 6). This enables me to provide an accessible introduction to the views of numerous prominent philosophers who have discussed the roles of values in scientific research, including Philip Kitcher and Janet Kourany (chapter 2), Elizabeth Anderson, Hugh Lacey, and Helen Longino (chapter 3), Kristen Intemann and Nany Tuana (chapter 4), Heather Douglas (chapter 5), John Dupré and Dan McKaughan (chapter 6), Kristin Shrader-Frechette (chapter 7), and many others. In keeping with the interdisciplinary character of the book, I am also able to touch on the views of major science policy and STS scholars, including Phil Brown (chapter 3), Roger Pielke Jr. and Daniel Sarewitz (chapter 5), and Steven Epstein, David Guston, Abby Kinchy, and Shobita Parthasarathy (chapter 7).

One disadvantage of the approach I have taken is that it does not allow me to provide an extensive philosophical justification of my own views about how to distinguish legitimate and illegitimate roles for values in science. In chapters 1 and 8, I provide a brief introduction to my own approach. I identify two scenarios in which values have a legitimate role to play in science. First, in many cases scientists are forced to make choices that are not completely settled by the available evidence but that serve some ethical or social values over others. Even if scientists are not deliberately trying to promote particular values when they make these choices, I contend that they should recognize the value-laden aspects of these decisions and take them into account. Second, I argue that values are justifiable in many contexts because they help scientists to achieve legitimate goals (e.g., doing their research in a manner that serves social needs and priorities).

When either of these two scenarios is present (i.e., when value influences are unavoidable or when they help to achieve legitimate goals), values have an appropriate role to play in science. In order to determine whether these scenarios are present and which values should be incorporated in scientific practice, however, additional conditions typically need to be met. I emphasize three conditions in this book: (1) scientists should be as *transparent* as possible about their data, methods, models, and assumptions so that value influences can be scrutinized; (2) scientists and policymakers should strive to incorporate values that are *representative* of major social and ethical priorities; and (3) appropriate forms of *engagement* should be fostered so that relevant stakeholders can help to identify and reflect on value influences. Some of these ideas are discussed in my previous work (e.g., Elliott 2011b, 2013a, b; Elliott and McKaughan 2014; Elliott and Resnik 2014; McKaughan and Elliott 2013). The motivation behind these conditions is that we should strive to support the most socially and ethically appropriate values possible, but there is bound to be disagreement about which values are best. Thus, it is important to make everyone aware of the values that are influencing science so that others can determine how their approach to science might differ based on their own values.

Fortunately, while my preferred approach differs from other philosophical work in some of its details, it agrees in its broad outlines with many other accounts about the major ways in which values can appropriately influence science. Therefore, my hope is that this book provides an accessible, effective introduction to the major philosophical views about how and why values can appropriately influence scientific research. Ultimately, I hope it also encourages thoughtful reflection about how we can guide the values that influence research so that we can better serve our ethical and social goals.

With this in mind, I would like to offer a few comments about the book's cover. It is an image from "The Unicorn in Captivity," the final tapestry in a seven-piece sequence known as the "Unicorn Tapestries." Housed at the Cloisters, a branch of the Metropolitan Museum of Art in New York City, these famous tapestries from the late Middle Ages describe the hunt for a unicorn. But the appropriateness of the image goes beyond the fact that it is a famous tapestry. The unicorn is a powerful symbol, and the sequence of tapestries is commonly interpreted to represent the courting of a bridegroom or the incarnation of Christ. Thus, it illustrates the values of love and religious commitment, which this book suggests are not as distinct from science as has often been assumed. I am also intrigued by the parallels between the hunt to capture and tame the elusive unicorn, and this book's account of the hunt to "tame science" so that it promotes our ethical and social values. Looking carefully at the tapestry, one can see juice from the fruits of the pomegranate tree falling on the unicorn's side. While typically interpreted as symbolic of the fruitfulness of marriage, perhaps in the context of this book they could also be interpreted as the fruits that we all hope science can generate for society.

Kevin C. Elliott
East Lansing, MI
May 2016

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I am very grateful to Michigan State University and to the Dean of Lyman Briggs College, Elizabeth Simmons, for the support I received to pursue this project. The core of my writing took place during the spring semester of 2015, when I had a course release from Briggs. Also, much of the motivation for pursuing this project stemmed from the focus on undergraduate education in Briggs and my desire to develop a textbook that would be useful for its introductory course in the History, Philosophy, and Sociology of Science. This book is much stronger because of the advice I received from the students who tested out the manuscript in my Fall 2015 Introduction to HPS course, my Spring 2016 STEPPS Capstone, and my Spring 2016 Graduate Seminar in Fisheries and Wildlife.

I am also grateful for the many colleagues with whom I have worked and studied. While I cannot remember exactly when I developed the idea for this book's title, I think it came from a conversation with Heather Douglas, who has also talked about scientific practice as a tapestry. My discussions with Heather have been invaluable for the development of my ideas about science and values. My friend Dan McKaughan has also had a major influence on this book, and readers will notice that many of the ideas in chapters 4 and 6 originated in articles that we wrote together. Chapter 4 also contains material I learned from writing an article with David Willmes. In addition, this book is full of insights I gleaned from Justin Biddle.

Janelle Elliott and Dan Steel read the entire manuscript and commented on it. Two anonymous reviewers for Oxford offered excellent suggestions on the original book proposal, and the reviewer for the penultimate version of the manuscript provided comments that improved the book significantly. I also gained important feedback about the book from Robyn Bluhm, Matt Brown, Erin Nash, Pat Soranno, the attendees of my presentation for the spring 2016 graduate conference on science and values at the University of Washington, and the participants at the 2016 meeting of the Consortium for Socially Relevant Philosophy of/in Science and Engineering. More broadly, I am grateful to the inspiration for thinking about science and values that Kristin Shrader-Frechette, Don Howard, and Janet Kourany provided at the

University of Notre Dame, and I am thankful for the countless conversations with other scholars that formed my thinking about these issues.

I am particularly grateful to my wife, Janet. I argue in this book that scientific practice is like a tapestry, composed of many different threads woven together. But my writing of this book was like a tapestry as well, insofar as my reading and writing and thinking were woven together with countless family activities. My work in this book reflects the many blessings I received from Janet and from our children, Jayden and Leah. I am dedicating this book to our children in hopes that it can help foster research efforts that make the world a better place for them and for their own children.

A Tapestry of Values

CHAPTER 1
An Introduction to Values in Science

On January 26, 1943, renowned Russian scientist Nikolai Ivanovich Vavilov died in a Soviet prison. His death is particularly horrifying, given that he starved to death after devoting his life's work to providing food for his country and the world. As a geneticist and agricultural scientist, he developed the insight that plant breeders should try to identify the geographical locations where key food crops evolved. In those regions, he suggested that scientists could find immense genetic diversity among the different crop varieties that still grew there. This genetic diversity could be used for breeding new crop varieties with valuable qualities, such as drought resistance, tolerance to extreme temperatures, and high yields. The search for improved varieties was crucial to the welfare of the Russian people because they were suffering perennial food shortages and famines. So, armed with his genetic insights, Vavilov set off across the world in search of seeds and samples.

Vavilov's story illustrates the problems that values can cause in science. Despite his work on behalf of the Russian people, he was ultimately sent to prison because Josef Stalin, the leader of the Soviet Union, became convinced that the genetic theory that undergirded Vavilov's work ran counter to the values of the Soviet leadership. Because of this clash of values, and because Stalin needed a scapegoat to blame for the failures of his collectivist agricultural program, he decided to suppress the field of genetics.

But values can also play very positive roles in science. After telling the story of Vavilov, this opening chapter recounts Theo Colborn's pioneering research on environmental pollution during the 1980s and 1990s. Colborn's story illustrates the many beneficial ways in which values can influence research. Together, the stories of Vavilov and Colborn highlight the importance of the two main questions that we will be exploring throughout this book. First, what are the major ways in which scientific reasoning can be influenced by values? Second, how can we tell whether those influences are acceptable or not? In preparation for answering those questions, the final sections of this chapter provide an overview of the book and clarify some of the philosophical ideas that we will explore throughout the following chapters.

VALUES IN THE STORY OF VAVILOV

In his efforts to develop agricultural breakthroughs that could help the Russian people, Vavilov ultimately launched more than two hundred expeditions around the globe and collected seeds from hundreds of thousands of plants. As recounted by his biographer, Peter Pringle, Vavilov's adventures were extraordinary. In 1916, he led an expedition to the Pamirs, a mountainous region on the border of Russia, Afghanistan, and China. Because the safest routes were too dangerous to pursue because of military conflicts, they had to go by horse over a treacherous glacier, and Vavilov and his horse almost fell to their deaths. In 1924, he guided the first Russian scientific expedition to Afghanistan, where he suffered from malaria and traveled through such dangerous areas that he struggled to find local guides willing to accompany him. In 1927, he traveled to Abyssinia (modern-day Ethiopia) and Eritrea. On that expedition, his team escaped from a group of armed men by gifting them with brandy and sneaking away while they were sleeping it off. On a trip through Spain, he was supposed to be followed by two police agents, but his schedule was so exhausting that they gave up following him during the day and agreed to catch up with him each night. He collected samples from around the world, including the United States, Canada, Western Europe, China, Japan, and Central and South America.

Vavilov's work was acclaimed both in the Soviet Union and internationally. In 1926, he received the Lenin Prize, the top Soviet award for scientific activity. In 1929, he became the youngest scientist ever to be elected as a full member of the USSR Academy of Sciences, and he became the director of the Lenin Academy of Agriculture. He was respected by the world's top geneticists, including Thomas Hunt Morgan and Hermann Muller. In Leningrad, he created the world's largest seed bank, which contained more than 250,000 samples, and he tested new plant varieties at 300 experiment stations that he oversaw across the Soviet Union. When the Nazis laid siege to Leningrad during World War II and the people of the city were starving, workers at Vavilov's institute faithfully guarded the seeds, and some of the workers even starved themselves rather than harming the collection. The passion with which these workers protected the collection illustrates the profoundly beneficial role that values can play in science.

Unfortunately, Vavilov's story is also frequently held up as a classic example of how values (in this case, political ideology) can harm science. It seems nearly inconceivable that a humanitarian and scientific hero of Vavilov's stature could end up starving to death in prison, but he was engaged in his plant breeding at the same time that Josef Stalin was collectivizing Soviet agriculture and repressing political dissidents. Stalin's policies aggravated the food shortages that already plagued the Soviet Union. In response, Stalin's administration placed increasing pressure on Vavilov to increase agricultural yields as quickly as possible, but Vavilov insisted that there were limits to the speed at which his breeding techniques could produce new advances. At the same time, an ambitious young scientist named Trofim Lysenko claimed to be able to make much swifter advances by pursuing different agricultural strategies.

According to Pringle, Lysenko was an example of what the Soviets called "barefoot scientists." These were researchers who had not graduated from a university and who focused on practical issues of direct relevance to the people. Beginning in 1927, the official newspaper of the communist party, *Pravda*, began drawing attention to Lysenko's work as a plant breeder. He claimed to be able to advance the yield of crops dramatically by altering the exposure of seeds to environmental factors like temperature, moisture, and light. Vavilov admired some aspects of Lysenko's work, but he and his fellow agricultural scientists also recognized that it suffered from errors, exaggerations, and perhaps fraud. Nevertheless, Lysenko's approach fit very well with the ruling party's Marxist philosophies that also emphasized the importance of environmental factors rather than inherited traits. Moreover, Lysenko was extremely strategic about using his peasant background and his lack of education to his advantage in a cultural setting that was extremely suspicious of the traditional intelligentsia.

Because Stalin was looking for scapegoats to blame for the failure of his collectivization program in the 1930s, Vavilov and his fellow geneticists became easy targets. For a long time, Vavilov attempted to promote peace with Lysenko, suggesting that his environmental approaches to agricultural science were complementary to the genetic breeding strategies that Vavilov pursued. Nevertheless, Lysenko chafed under the criticisms that his work received from many of Vavilov's fellow geneticists. As Lysenko gained more and more power in the Soviet hierarchy, he became increasingly aggressive about labeling the field of genetics as a false, Western, "bourgeois" approach to science. By 1938, Lysenko became the president of the Lenin Academy of Agriculture that Vavilov had led until his falling-out with the Soviet political establishment. Meanwhile, Stalin was engaging in vicious purges of vast numbers of people accused of being "counter-revolutionaries," and geneticists were increasingly placed into that category by the late 1930s.

While some geneticists were being executed, Vavilov remained free for the time being. He may have benefited from his international stature and Stalin's desire to avoid attracting unwanted attention to his reign of terror. Nevertheless, the Soviet leadership ultimately plotted to arrest Vavilov quietly while he was on an expedition to western Ukraine. On August 6, 1940, he was seized and taken to jail. He was interrogated nearly four hundred times over the next 11 months. Between August 10 and August 24, he was interrogated for 120 hours while being subjected to severe sleep deprivation. By the end of August, he confessed to the false charge of being a member of a "rightist" organization within the agricultural system, but he refused to confess to espionage despite unrelenting interrogations throughout the following year. Based on fraudulent testimony, he was ultimately convicted of espionage and sentenced to death. On appeal, he received a reduction of his sentence and was allowed to remain in jail, but the grim conditions of his incarceration led to his death a year and a half later.

The Soviet adoption and defense of Lysenkoism, and the accompanying persecution of scientists who held differing views, is frequently held up as a prime example of the dangerous consequences that can arise when values are allowed to influence science. If science is not kept pure of political, religious, and ethical values, so the worry goes, it runs the risk of being hijacked by ideologies that prevent scientists from arriving at the truth. This criticism of Lysenkoism may not be entirely fair, however. Lysenko was often labeled a "pseudoscientist" during the middle decades of the twentieth century, but more recent scholarship has shown that the situation was somewhat more complicated. While his efforts to abandon traditional genetics were poorly defended, his initial research showing that exposure to low temperatures could hasten the development of crops was well received by the scientific community. Moreover, his research was informed by the goal of integrating theoretical work with practical concerns, which was an important priority of the Soviet Union at that time. The following chapters argue that under the right conditions, it can be acceptable for science to be informed by these sorts of practical aims.

Thus, the story of Vavilov and Lysenko appears to be problematic not solely because values played a role in Lysenko's research but rather because the case failed to meet additional conditions that are important for incorporating values in a legitimate fashion. The most obvious problem was that many scientists who resisted Lysenko's favored approaches were brutally repressed. Those who challenged his views about genetics were often imprisoned or killed, and even those who were not arrested were afraid to provide critical feedback about Lysenko's work. As a result, scholars were not able to engage critically with his research and discuss its quality. Another worry about Lysenko's work is that, perhaps because of his limited training, his experiments and results were not described carefully. This lack of transparency made it even more difficult for the scientific community to evaluate it. We will return throughout this book to the importance of both critical engagement and transparency if values are to be incorporated appropriately in scientific research.

VALUES IN THE STORY OF COLBORN

Consider another, more recent story involving values in science. When Theodora (Theo) Colborn passed away in December 2014, she was hailed for launching a revolution in our understanding of environmental pollution. She was frequently compared to the pioneering environmentalist Rachel Carson because of their similar efforts to highlight the hazards associated with toxic chemicals. It is therefore fitting that Colborn received numerous awards named after Carson, as well as a variety of other honors, including the Blue Planet Prize, which is often regarded as the Nobel Prize for the environmental sciences.

Colborn's eventual impact would have seemed highly unlikely in 1978, when she was a 51-year-old retired pharmacist who decided to embark on a new career path. She was living near Rocky Mountain Biological Laboratory in Colorado and had been motivated by her love of birds to help volunteer for environmental organizations. In order to develop more compelling credentials, she decided to pursue a master's degree in ecology, and she went on to earn a PhD in zoology from the University of Wisconsin–Madison. After she finished her degree in 1985, she received a fellowship to work for the US Office of Technology Assessment in Washington, DC. In 1987, she received a position at a nonprofit think tank called the Conservation Foundation to study the effects of environmental pollution in the Great Lakes region.

At that time, scientists were especially focused on the concern that toxic chemicals released into the environment were causing cancers in humans and wildlife. Nevertheless, she could not find compelling evidence that people living in the Great Lakes region were suffering from abnormally high rates of cancer. She did find, however, that the animals living in the region were experiencing a wide range of surprising abnormalities. For example, in some herring gull colonies, scientists were finding two females in a nest rather than a male and a female, apparently because of a shortage of males. Researchers also observed strange parental behavior in various bird species—they seemed less interested than normal in defending their nests and incubating the eggs. Many birds were also born with deformities, and other animals, such as mink, were having trouble reproducing. Colborn recognized that something was wrong, but these findings did not fit the cancer paradigm within which most scientists were working.

Colborn ultimately synthesized a number of findings and led the development of a new paradigm for approaching environmental pollution. She realized that many of the problems faced by organisms in the Great Lakes were related to reproduction and development, especially in the offspring of adults exposed to pollutants. Building on experimental work performed by other scientists, she proposed that many chemicals were generating harmful effects by interfering with animals' hormonal systems. Because the hormonal system is deeply intertwined with the immune system and the neurological system as well as the process of development, environmental pollutants could cause a wide array of problems by altering hormones. In some cases, the harmful effects could involve cancers, but a wide variety of other consequences could also result.

These harmful health effects (which Colborn called "endocrine disruption") have raised a number of new concerns for scientists and policymakers. Because organisms are sensitive to extremely low levels of hormones, especially during sensitive periods of fetal development, some scientists worry that environmental pollutants acting in this manner could cause problems at much lower dose levels than previously thought. The effects of endocrine disruptors are also difficult to study; they may generate a number of subtle consequences that are more difficult to recognize than cancer, they may cause different problems at low doses than at higher doses, and they may generate effects only when organisms are exposed to them at crucial "windows" of development. Some scientists worry that humans are already experiencing harmful effects from exposure to endocrine-disrupting chemicals. These may include birth defects, infertility, weakened immune systems, attention-deficit disorders, decreased male sperm counts, and cancers.

What is particularly noteworthy for the purposes of this book is that values influenced Colborn's pioneering research on endocrine disruption in a variety of ways. First, her discovery of the phenomenon was due in large part to her passion for protecting the environment. She would not have pursued a new career as an environmental scientist—let alone engage in hours of detective work to pore over research articles on the plight of Great Lakes wildlife—if it were not for her strong environmental values. Then, she worked with others to write a popular book, *Our Stolen Future*, which drew attention to the potential hazards associated with endocrine-disrupting chemicals. Because of the authors' strong concerns about public health, they thought it was important to give people clear warnings about the potential threats they faced. Colborn's concerns about public welfare ultimately drove her to found an international nonprofit organization, The Endocrine Disruption Exchange (TEDX), in order to facilitate the compilation and dissemination of information about endocrine disruptors.

In contrast to the case of Lysenko, values appear to have played a largely positive role in Colborn's research. Nevertheless, her work has not entirely escaped controversy. Critics have complained that she sometimes leaped ahead of the scientific evidence and drew stronger conclusions than they thought the evidence warranted. In particular, her book *Our Stolen Future* was criticized for being too aggressive about drawing the conclusion that humans were being harmed by the levels of endocrine-disrupting chemicals currently present in the environment. The critics worried that it was irresponsible to arouse public concerns while the evidence was still highly uncertain.