issues that surround any international agreement, appropriate action was taken, in small steps at first, and then more quickly as the science became clearer and the economic costs decreased with new research into CFC alternatives. It is not beyond imagination that a similar path could be followed in dealing with climate change.

SCIENTIFIC PRACTICE

> **The great tragedy of science—the slaying of a beautiful hypothesis by an ugly fact.**
>
> **—Thomas Huxley**

Science has proved the most reliable and self-correcting method ever devised by humans for finding empirical truths about the real world. Science tests hypotheses rigorously, and mercilessly tosses aside hypotheses that cannot explain the data. The more often a hypothesis is tested and not rejected, the more reliable we judge it to be. Those scientific theories that make interesting predictions gain credence if they are successful.

Over time, a solid foundation of knowledge builds up that has been tested again and again. This body of knowledge, or consensus, may be thought of as the best available synthesis of what is understood on that topic. However, a consensus is not inviolable. Parts of many ideas once thought reliable have indeed been rejected in the light of new discoveries. For instance, Newton's laws of motion were accepted for two hundred years before being shown to break down at very large and very small scales. In the early twentieth century, Newton's laws were replaced by quantum mechanics and general relativity at those extremes (though they are still used very successfully in most everyday applications, such as designing airplane wings or weather forecasting). Sometimes valid ideas, such as Alfred Wegener's theory of continental drift, take time to be accepted. However, once it is clear that a new theory explains observations better than the previous theory and that its predictions have been validated, the scientific community will switch over very quickly. For continental drift, that point came in the 1960s, when unequivocal evidence of sea-floor spreading at mid-ocean ridges gave rise to the theory of plate tectonics, suddenly making sense of many different anomalies, including those highlighted by Wegener decades before. It is this openness to change that distinguishes science from dogma.

Scientists must therefore be professional skeptics, always examining how theoretical assumptions are constructed and how observations are interpreted. Scientific statements that reach consensus level do so because they have withstood many such tests from some of the brightest people around. These statements might still be wrong, but with every test they pass, that becomes less likely.

Many scientific issues, from genetic engineering to climate change, are controversial because they have significant political, economic, or ethical implications. These implications have led to a welcome interest in climate change from the public as well as to an unwelcome abuse and distortion of scientific results for political purposes. Neither attention can be divorced from the other. So, in the public eye at least, climate science appears far more politicized and polarized than it is among climate scientists.

A flip side to this perceived politicization of climate science is the use of scientific language and results by politicians and pundits to "conduct politics by other means." This "scientization" of the political debate has led to lawyers and political pundits discussing the ice age cycles of a quarter million years ago, or fifteenth-century tree rings, as if these past events had some relevance for current environmental policy. While these issues are interesting scientifically (and are covered in this book), their use in modern political contexts is designed to lead to confusion rather than enlightenment.

In any subject as vast and complicated as climate, there will always be anomalies and apparent contradictions in observations, theories, and models. Over time many of these issues work themselves out. Possibly the data were corrupted by a nonclimatic influence. Maybe the interpretation was revised in light of new information. Or the analysis was corrected. Or a new piece of physics was found to be important. At any one time, scientists have many problems within a theory, model, or set of conclusions for which the resolution has not yet been found, and for some, it may never be. A determined critic can often pull together a compelling collection of caveats and contradictions that seemingly turns conventional scientific wisdom on its head. The Internet and the op-ed pages abound with examples of this, on subjects as diverse as evolution, tobacco addiction, and mercury levels in fish.

The problem with these pick-and-choose arguments is that they are constructed to support an already existing view—for instance, that climate change can't possibly be due to human activity. Their creators selectively ignore the far more compelling evidence that contradicts their point of view. This salad bar approach to scientific facts turns normal scientific practice on its head. Like a jury a serving on a trial, scientists are supposed to keep an open mind and come to the conclusion after examining all the evidence, not before.

Partial and distorted readings of scientific findings to support a predetermined political or moral position are nothing new. Regardless of the subject, the techniques used are often the same: distorters overinterpret or misinterpret true but irrelevant facts. They set up straw man arguments that no one has advocated so that they can easily be knocked down, using these as substitutes for similar-sounding ideas of well-supported science. They give non-peer-reviewed opinions as much weight as the assessment of thousands of scientists. They use specific cherry-picked examples to contradict general conclusions—for instance, using the information about one mountain glacier that is advancing to counter the fact that the vast majority are not.

What is the antidote to this unscientific thinking? It is not for scientists to simply dismiss such flimsy claims and argue from authority that the conventional view is correct. On the contrary, scientists need to use the interest and curiosity piqued by these arguments—and more important, the underlying concerns they reveal—as an open door to the public and a chance to demonstrate why scientists have come to the conclusions that they have. On their own, fuller explanations to the public, such as this illustrated book, will not solve the underlying political issues. After all, a general understanding that climate change is happening doesn't translate into everyone agreeing what to do about it, but it does improve the trust that the public has in science. As in so many areas, the answer to bad information is better information.

This book does not attempt to debunk every contrary notion in circulation Instead, we focus on the reasons why scientists think the way they do. Our Further Reading section lists online resources that are reliable and can be consulted for discussions of nonscientific ideas that we do not specifically cover. Where we find true uncertainty, such as in the potential impact of climate change on extreme events, we make that clear. Where the science is not yet complete for all aspects of the specific problem, we describe what is known and why.

What should be clear from reading this book is that we have concluded, as have scientists, assessment panels, and national academies all over the world, that human-induced climate change is ongoing and has the potential to create dangerous consequences for human society if we continue down a business-as-usual path. We do not, however, advocate for any particular solution to this problem. These potential solutions, both technological and political, are discussed in the last section of the book, but decisions on which options to pursue are fundamentally political. While these decisions can be guided by science, they cannot be determined by science alone. We hope that our contributions to this debate—both scientific and photographic—will be a useful guide.