

A CRISIS LIKE NO OTHER:
UNDERSTANDING AND DEFEATING
GLOBAL WARMING



Robert De Saro

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**A Crisis like No Other:
Understanding and Defeating
Global Warming**

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A Crisis like No Other: Understanding and Defeating Global Warming

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What is the meaning of life?

There is none.

Deal with it.

But my two sons and their families
come awfully damn close.

ENDORSEMENTS

A Crisis Like No Other is an excellent discourse on global warming topics that defines the many facets of the problem and covers its solutions as well as the politics involved. The read is a pleasure, with a daring and engaging style, making it useful to inform the reader on this pressing problem. This is an unusually well-written cross-over book that is suitable for the general reader as well as for college students in climate change, sustainability, and environmental science courses.

It covers a multitude of complex topics in an easily accessible manner, no matter the reader's technical background. For the reader's benefit, it includes examples, clever stories and anecdotes, and is packed with meticulously researched information as well as relying on the author's own expertise.

I highly recommend it.

—Carlos Romero, Director, Lehigh University Energy Research Center; and Fellow at Lehigh University

Bob De Saro's analysis of the situation along with suggested pathways to address an existential threat to our planet is refreshing, educational as well as an entertaining read.

A Crisis Like No Other covers all the topics a reader needs to thoroughly understand and take action on global warming. From the psychology of global warming denial and how to see through lies and fake news, to the science of global warming, to what we must do to solve it, and much more.

This alone would make it a valuable read but it is also written in a convincing and entertaining matter, filled with insight and wit. You will not be able to put this book down.

I recommend it for both the general reader and as a collegelevel book on environmental and sustainability science.

—Diran Apelian, Distinguished Professor, University of California, Irvine

What this Book is About

“*Hell hath no fury like a woman scorned,*” and Mother Nature has been scorned, misused, ignored, and insulted for the past 250 years. She is one ticked-off lady.

Why?

Because ours is a world getting hotter. Consider:

- The 1980s was the hottest decade on record.
- Until the 1990s surpassed it.
- And then the 2000s came along and beat the 1990s.
- 2010s? You guessed it. It took the crown.
- Now, our present decade of the 2020s is beating them all.

It’s undeniable that global warming is occurring and we are responsible for it. And it is not good since global warming is causing rising sea levels, bigger storms, hotter temperatures, flooding, and drought. I could go on. All of which affect our well-being and that of our children and theirs, even more.

Still, we can emerge from global warming, maybe not unscathed, but mostly intact. To do so requires understanding what global warming is, how we can defeat it, and the bridges connecting the two.

A Crisis Like No Other: Understanding and Defeating Global Warming provides this understanding. It consists of four parts. The first part covers the psychology of global warming denial, how to defend ourselves against it, and how to convince others of global warming’s grave harm. Part II describes what global warming is. The third part answers the question *What makes us so sure?* Finally, Part IV provides a road map to defeating it.

Part I. We Have Met the Enemy and He Is Us—Pogo

Facts and evidence are not always what they seem. The reason? We all have built-in biases and unswerving beliefs that filter and sometimes distort the truth. For example, why is a refs whistle a travesty when called against our team but deserved punishment when called against our opponent? It’s simple. We see what we wish to see. So it is with global warming. Part I describes how we filter facts, driven chiefly by our subjective beliefs, which then push some of us to deny global warming despite the overwhelming evidence.

With that understanding in hand, part I goes on to discuss how to convince people to take action on global warming. It is surprisingly straightforward. We convince people of global warming’s harm not by overwhelming them with facts but rather by appealing to what they already believe and understand to be common sense. People will listen if our arguments are crafted to fit their beliefs.

But to convince others of global warming and to understand it ourselves, we must first see through the lies and half-truths that come at us every day. Part I concludes by describing how

we are built to fall for lies and how to defend ourselves from them. Uncovering the truth is not difficult if we have the proper tools. Ten easy-to-learn and logical techniques are given, along with examples.

Part II. The What's and How's of Global Warming

With part I as our foundation, we can now open our minds to understand what global warming is. Part II starts by describing how greenhouse gases are created from burning fuels and how they skew our planet's energy balance, leading to rising temperatures. The description is clear, accurate, and easy to understand. But global warming is not just about rising temperatures, as important as that is. It is also causing monster storms, droughts, floods, diseases, political instability, food shortages, mass extinctions, and increased violence—all of which are described in this book, with reasons given for each.

But to prioritize our actions, we need to know the source of the worst greenhouse gas generators. Mostly it's carbon dioxide (CO₂), but methane and some other bit actors play a role as well. The sources include industry, electric generating plants, and transportation. Oh, and cow burps.

Part III. Why We Believe Global Warming Is Real and Significant

Irrefutable evidence proves global warming is real and threatening. It's the same as when a thermometer placed under your tongue shows you have a fever. There is no one denying it. In the same way, with global warming, there are myriad measurements, mathematical models, experts from around the world, and much more, all converging onto this one unambiguous truth.

But to believe the evidence, we must also have a sound understanding of how science works, including its triumphs and failures. Science deals exclusively with facts, data, and measurements that either confirm our view of reality or reject it as being untrue. This process is repeated until our understanding of reality matches the evidence and is therefore confirmed. Part III describes more, but the evidence is science's bedrock and North Star.

However, nothing in life can ever be certain, including science. Part III explains the limits of how accurately we can know anything. Two types of uncertainties are explained: (1) that which is due to our limited but growing knowledge and (2) that which will forever be out of our reach since we are incapable of measuring (and therefore truly understanding) some parts of it. Part III goes on to explain how scientific decisions are made despite these uncertainties.

Still not convinced about global warming? Then ask those who have the most to lose. This part concludes by showing the military's grave concerns about global warming and its effect on their operations and bases. The military never kids around, and their anxiety about global warming should also be ours. Similarly, the insurance and financial sectors are getting sweaty palms over what could happen to their insured and investments.

Part IV. The Final Verdict

The last part of this book explains how bad the climate crisis is and what we must do to solve it. For instance, there are tipping points lurking out of sight, ready to pounce—ocean acidification, rising sea levels, melting glaciers, and thawing permafrost. But one tipping point that often gets overlooked is the ominous danger to our democracy. Global warming could lead to civil strife, creating opportunities for those wishing to sidestep our Constitution

to acquire unlawful powers. We must stay alert to these dangers and add them to our incentives for fighting global warming.

Nevertheless, there is a clear path to solving our climate crisis. Three activities must be undertaken. The first is the technologies we need to deploy. The second is the decisions we must make in choosing our leaders and sidestepping the influencers who have fossil energy hidden agendas. And finally, it's all about us—the personal actions we need to take.

A Crisis Like No Other starts with the psychology of denial, moves to understand global warming and the science behind it, and wraps up with a road map on what we must do. That's how we beat global warming.

Mother Nature would approve.

A Few Additional Notes on the Book's Organization

Each part, indeed each chapter, can be read independently of the others, so you can skip around if you wish. For instance, if you want to get into the meat of what global warming is, then go straight to part II. Or if you are a direct action, no-nonsense sort of person, then go to part IV to get started on what we must do. Besides, you now own this book, so I suppose you can do as you please and never mind what I think.

Except I will need to walk that back a bit—not the owning thing, the jumping around thing. Some of the chapters refer to two or three ideas developed in chapter I, so maybe it would be best to read that one first (after all, it's the first chapter for a reason).

For your enjoyment, I end each chapter with an “Afterthought,” which is an engaging and sometimes humorous short take on one of the points in each chapter. But no peeking. Read the chapter first before the Afterthought. Yes, I know. You own the book and you'll do whatever you very well please. We already established that point. I'm just suggesting, is all.

I also sprinkle in “Asides” throughout the book, which provides interesting tidbits right after a particular concept is developed. You have no choice but to read them in the order I wrote them since I am not going to tell you where they are. I think I won this round. We're tied at one all.

Bye for now. I'll see you in chapter 1. Or whichever chapter your fancy takes you to.

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Part I. We Have Met the Enemy and He Is Us—Pogo

Part I covers the psychology of global warming denial, how to convince others of the crisis, and how to see through the many lies and conspiracy theories that can easily confuse us.

CHAPTER 1

Why We Deny Global Warming

“There is absolute proof.”

“They won’t listen. You know why? Because they have certain fixed notions. . . . Any change would be blasphemy in their eyes, even if it were the truth. They don’t want the truth. They want their traditions.”

“We could try.”

“We would fail.”

—Isaac Asimov, *Pebble in the Sky*, 1950

Global warming is happening. It’s happening now. It will continue to happen. And we are responsible for it. These facts are inescapable, and denying them—especially when you consider all that is at stake—is irrational to the point of madness. But deny it people do:

“The science is not settled, and the science is actually going the other way. . . . We may in fact be going into a cooling period.”

—Joe Barton, Former Congressman (R-Texas)

“Climate scientists deserve to be flogged.”

—Marc Morano, ClimateDepot.com

“On average, global warming is not going to harm the developing world.”

—Bjorn Lomborg, Copenhagen Consensus Center

“The Great Hoax: How the Global Warming Conspiracy Threatens Your Future.”

—Senator James Inhofe (R-Oklahoma)

“CO₂ plays only a minimal role.”

“More CO₂ will benefit the World. The only way to limit CO₂ would be to stop using fossil fuels, which I think would be a profoundly immoral and irrational policy.”

—Michael Halpern, Program Manager, Union of Concerned Citizens

Despite these wacky statements, people rarely make illogical decisions. As a species, we have flourished for over two hundred thousand years. Not as good as the dinosaurs, certainly, but not bad at all. Do you think we would still be around if we made reckless decisions not driven by our survival needs? We would not. Throughout our brief history we have always made sound choices, and, outward appearances aside, those choices have been steeped in logic and need. The above statements are no exception.

Then what gives?

The answer involves understanding how we think, how we make decisions, what subconscious forces drive our decisions, and how they help us survive and thrive. Most importantly, it's about how we mercilessly discard facts that don't support our beliefs.

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CHAPTER 2

Only through their Beliefs and Emotions can we Reach their Minds

What a man had rather were true, he more readily believes.

—*Sir Francis Bacon, 1868*

The NY Yankees baseball team has won a quarter of all possible championships, an astounding feat unmatched by any team in any major sport. So in light of this indisputable fact, tell the next Bostonian you meet to drop the Sox and root for the Yanks. You can guess the outcome, and it's not going to be pretty.

In trying to convince someone, facts will not work if those facts challenge a person's Metabeliefs or their sense of who they are especially as it relates to their friends, relatives, and others they admire. As Michael Shermer writes, "People with more knowledge only accept [facts] when it doesn't conflict with their preexisting beliefs and values. Otherwise they use that knowledge to more strongly justify their own positions ¹".

Facts can be ignored, changed, or bent to anyone's purpose. For instance, look at people who believe the earth is flat. They go to great lengths to overcome the obvious facts arrayed against them, and do so with extraordinary oblivion to the real world: "They believe the Earth is a disc with the Arctic Circle in the center and Antarctica, a 150-foot-tall wall of ice, around the rim. NASA employees, they say, guard this ice wall to prevent people from climbing over and falling off the disc ²". You can't make this shit up.

The way a person decides on major issues is the same way they decide on their sports team. Their thoughts are shaped by their Metabeliefs, their friends and relatives, where they live, and so on. Facts may come into play but only as bit actors in the background of a much larger unfolding drama.

This leads to a problem with consequences that will shape history and our well-being, if not our survival. We must convince people to take action, but doing it only with facts is like throwing pebbles at a charging rhino. It doesn't work. Actually, it leaves us worse off, since facts, true or not, will only harden a

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person's convictions, leaving them even less susceptible to change, especially (as Katharine Hayhoe notes) if they see it as an attack on their identity and way of life. We are just annoying the rhino ³.

So to convince folks about the need for global warming action, we must tailor our message to fit in with their beliefs, how they view the world, how they think of themselves, what is important to them, and what their hot buttons are.

This isn't going to work all the time and maybe not even most of the time, but hopefully often enough to be successful, the same way a vaccine provides herd immunity: if enough people take action, the rest will be saved.

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CHAPTER 3

Finding the Truth Amidst a Sea of Lies

“A lie by any other name is still a lie”

—appropriated from Shakespeare

Hucksters pedaling deceit and half-truths are as old as humanity, starting when Adam and Eve were ejected from Paradise because they could not recognize the serpent’s lies. I guess when you live in Paradise, there is little reason to be on your guard.

Their fall should not be surprising since we are built to survive, not to uncover the truth¹. If the truth gets in the way, it becomes nothing more than collateral damage. Think about it for a moment. If strength can’t overcome the alpha male, then deception is the only way left. And it usually works quite well.

So why then should we care about the truth? What good does it do us? Might it even be better to embrace lies so as to advance our cause? Fight fire with fire, so perhaps we should attack their lies with our own lies, their falsehoods with our own better-crafted falsehoods. Meet them head-on with a stronger narrative neglecting all facts that don’t support our position. Why not surrender and sign the devil’s pact if it gets us what we want?

There are lots of reasons. First, our integrity and the legacy we leave to our children and grandchildren should be important to all of us. Lies tarnish both. Do we want to be remembered like Lance Armstrong, who acknowledged he lied “10,000 times” during his infamous doping scandal²?

Most importantly, lies drastically hurt society by forcing poor, even catastrophic, decisions. How can the outcome of any decision be good if it is based on lies? The tobacco industry lied about the hazards of smoking, which now leads to 480,000 deaths annually³. Not good.

And to be a bit melodramatic, the truth will always win. Not at first maybe, but eventually. It took hundreds of years for people to accept the earth revolves around the sun, and for giants like Copernicus, Galileo, and Kepler to achieve it. But eventually, the truth won out.

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All lies die—they are no match for reality. But during their lifetime they can do a boatload of harm. Just look at the global warming damage already incurred because fossil energy companies want to sustain their profits as they put up obstacles at every turn. They have even been accused of misleading their own investors on the global warming costs to their bottom line^{4, 5}. And now, thanks to their persistence and our acquiescence, we are undergoing record heat waves across the globe, crumbling arctic ice, leading to dangerous sea level rises and mass extinctions seen only five other times throughout earth's 4.5-billion-year history.

As Adam and Eve found, we must defend ourselves from lies. And while we can't go back to Paradise, we can protect the second best—our world as it is today—from global warming's ravages.

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Part II. The What's and How's of Global Warming

Part II provides the details of global warming: what it is, what causes it, what problems it leads to, and who is most responsible.

Energy Drives Global Warming

Riddle me this: What is it that never gets smaller no matter how much is taken from it?

Sun Tzu, in his masterful book, *The Art of War*, instructed Asian generals on military strategies, terrain, engagement, espionage, attacking; essentially all the skills needed to win a war. But likely his most important advice was:

“Know the enemy . . . and victory is never in doubt.”

Global warming is clearly an enemy bent on our destruction, no different than an invading army. It has already started wildfires, flooded cities, killed thousands, and destroyed our crops. So with Sun Tzu’s spirit beside us, we need to understand global warming as intuitively as we know the faces of our loved ones if we are to arrest its unrelenting march against us.

And who are we to argue with a book that has been selling for over two thousand years?

It’s not complicated. The unfortunate effects of global warming are mostly from energy; or more precisely, energy’s use and how it travels from one place to another. And it goes like this. We burn fuels for their energy; they produce gaseous emissions, among which is carbon dioxide (CO₂); which in turn acts as an insulating blanket in our air. Radiative heat from the sun warms our planet, but less of it can escape back out due to this blanket, so we get warmer. And the more CO₂, the thicker the blanket, and the warmer we get.

Understanding global warming and its consequences is the first step in slowing it, reversing it, and finally defeating it.

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A Road Map to this Chapter

You know what a nice day for me is? It's when the next person who tells me "have a nice day" steps into an open manhole filled with alligators while cement is pouring into it. Now, there's the making of a really nice day. I meditate by clearing my mind of all thoughts except for that one image. Ah, nirvana.

It's the same with those socially challenged souls who tell me to "be safe." Yup, if they didn't tell me that, who knows what would happen. I might run headfirst into a brick wall or stick a wet finger into an electrical outlet. No telling what I might do without their timely instruction.

CO₂ is that kind of a person. Well-meaning and useful in small quantities but just so damned annoying when there's too much of it.

And it's the reason why temperatures are going up. Now understand, excess CO₂ doesn't increase our planet's temperature. Rather it increases its energy. So it is important we know the difference between the two.

That's the first thing covered: energy, how energy influences the heat content of our planet, and how that dictates its temperature.

For our home world, the energy balance, and therefore its resulting temperature, is due to three sources of heat radiation: the sun heating the earth, the earth reflecting some of that back out into space, and the earth emitting its own heat.

Think of cuddling on a sofa in front of a fireplace. Like the sun, the fireplace heats us up. And like the earth, we can feel the heat emanating from our partner. Put a screen between us and the fireplace and some of its heat will reflect away, cooling us down. Wrap ourselves in a blanket and we get hotter.

Which brings us back to CO₂. It is the blanket that keeps the heat from escaping. Add more blankets and we get hotter still. You'd think we would want to stop with piling on all these blankets, but maybe we are too distracted to notice. So more blankets, less heat escapes, and the hotter we get.

Where is this endless number of blankets coming from? Getting off the couch for a moment and back to reality, our CO₂ blankets come from burning fuels: gasoline, natural gas, oil, and the thickest blanket of all, coal.

There's more to it, but this is enough of a map to find our way, without stepping into any open manholes. So enjoy the rest of the chapter. Oh, and have a nice day.

CHAPTER 5

Rising Temperatures are a Problem, but Not the Only Problem

“The world has moved on.”

—Roland Deschain, in The Dark Tower, by Stephen King

CO₂ is insulating our world, leading to rising air temperatures. That much is certain. The IPCC has reviewed years of data and concluded that the world’s average air temperature has already heated by 1.8°F (1°C) compared to preindustrial times. And they suggest we cease all greenhouse gas emissions by 2050 to keep the temperature rise to 2.7°F (1.5°C) or face serious life-changing consequences from the additional heat.

We might think that 2.7°F is lost in the noise, invisible in our daily weather that changes every day. We would be wrong. The amount of heat needed for such a rise is enormous,ⁱ and it represents a permanent increase over and above the weather fluctuations we see every day. It’s like a rising tide that lifts the changing waves even higher than they would be otherwise. But it is also a tide that never retreats and keeps rising with no end in sight, covering the entire planet, not just a local beach. And it makes the extreme limits of the temperatures ever more extreme.

While bad enough, rising temperatures cascade into other problems making the outlook even more challenging. Because our world is intricately interconnected, one problem begets many others. An illness never affects one part of our body. A simple seasonal flu results in a fever, coughing, lethargy, weakness, and appetite loss. That’s because, like our world, our body is also intricately interconnected. No one organ is isolated from the rest. Each depends on all the others to function. So it is with our planet.

Global warming has changed our world and it is never going back to the way it was. It has moved on. This is also certain. But by understanding these issues, we can arrest them and adapt. Understanding comes first. Then wisdom and then change. It is in our hands.

ⁱ It is enough energy to run the entire U.S. for the next six million years.

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Air and Ocean Temperatures are Increasing

The oceans have saved humanity more than you could ever know. They absorbed a monstrous right hook from global warming by capturing over 93 percent of its heat ⁱ. Think about that, what would have happened if more of that heat went into the air? The air temperature has already increased by 1.8°F,ⁱⁱ so how much further would it have gone if the oceans had been less generous? I'll leave that one locked up in my closet of anxieties.

There are good reasons for the oceans' largesse. First, oceans cover almost three-quarters of the earth's surface, so most of the sun's incoming radiation lands squarely on them. Second, the oceans act as a container for this flowing heat, as it can't escape out the bottom and therefore it remains captured. Third, the oceans' ability to hold heat is 1,000 times greater than the air because its mass is 250 times larger and also because water, pound for pound, can hold four times as much heat as can air. Finally, oceans can't radiate their heat back into space as well as land and ice, so they have an additional warming blanket covering them.

All in all, a lucky combination of ocean properties that have saved us. For now anyway.

But what the oceans take away they also give back. All of the heat they've been squirreling away is going to escape at some point and add to our already increased air temperature. Heat is not a homebody but loves to travel and will go downhill to something that is only slightly cooler than where it started from. So as the oceans absorb more heat, their temperature increases and at some point it will rise above the air's temperature and will gush out its heat with great enthusiasm.

It will not happen overnight because everything in life takes time. When it comes to moving heat around, the earth is downright lazy since it has considerable thermal inertia and it will be a while for its temperature to catch up to the heat imbalance. It's a delicate dance and it takes about forty years to finish, which is a blessing and a curse. A blessing because it delays the true damage we are taking and a curse because it masks the problem.

So, getting back to the IPCC's goal of limiting our temperature rise to 2.7°F; even if we achieve it, after forty years the oceans will add about another 1°F and we will be at a 3.8°F rise. No matter how you slice it, the earth's temperature will continue to increase at least for the next forty years and very likely will continue after that because we are not doing enough to eliminate greenhouse gases.

What will the new normal be like? Some local summer temperatures can be instructive as to what we will face. Summer temperatures will rise higher than the

ⁱⁱ This temperature rise, as defined by the IPCC, is the average air temperature at ground and sea level cross the globe as compared to the same average from 1850 to 1900.

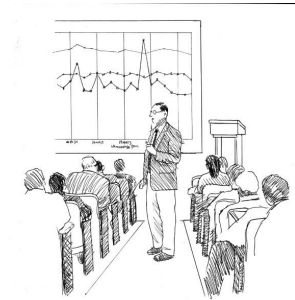
CHAPTER 6

Where Heat Trapping Gases Come From

"What's done cannot be undone."

—Lady Macbeth, Shakespeare

Place in decreasing order the greenhouse gas emissions the following are responsible for:



(a)



(b)



(c)



(d)



(e)



(f)

Every year we put into the air an amount of CO₂ equal to the weight of the entire earth's population—sixty-five times over. That's a lot of anything, but when it is CO₂, it is more than we can afford. A little is okay, and in fact a little CO₂ is as necessary for our survival just as too much threatens it. Too little CO₂ and we will have another ice age. But too much will bring on a global warming Armageddon. We need to have enough CO₂ to hold some heat in but not too much or too little. And that's what we have had for over ten thousand years. Earth was in the Goldilocks zone with just the right amount.

We must keep it that way, but over the last one hundred years we have been struggling with an unhealthy increase and the three bears are noticing. We can't change the past, so there is no point worrying about it or pointing fingers. But we can change the future and the first step is to understand the present; what our greenhouse gases are and where they come from.

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Part III. Why We Believe Global Warming Is Real and Significant

While part II showed why global warming is occurring, part III covers why we are so sure of it.

CHAPTER 7

Global Warming is Undeniable. Here's Why

"It's really not rocket science. You look at the evidence."

—Michael Sherwin, Acting U.S. Attorney for the District of Columbia

Nero Wolfe, Philip Marlowe, Jane Marple, Hercule Poirot—all understood a basic truth: evidence convicts the murderer. Nothing else can.

The same approach, the only possible approach, tells us that global warming is real and we are the cause. It is based on sound scientific principles, including satellite data, modern recorded measurements, complex models, prehistory data, and thousands of experts devoting their professional lives studying it. The evidence and facts are overwhelming and come from many independent and converging sources. There are no conspiracy theories, propaganda or flashy social media stunts, or a run at our emotions at play here. Just the truth.

And while there are no absolute truths in this imperfect world of ours, there are enough facts and evidence to lay claim to global warming's reality. Not absolute, but as close as mortals can get.

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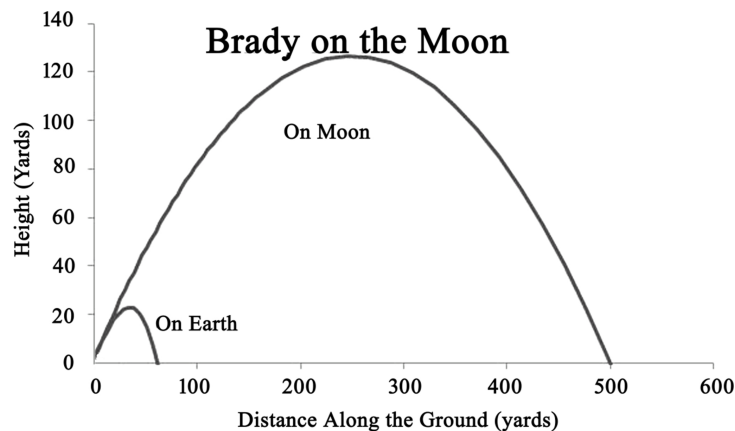
How Far Can Tom Brady Throw a Football On The Moon?

Now there's an interesting question. Any guesses? The direct approach is to rocket Brady to the moon and have him throw a football and measure its distance. Easy peasy, you might say, so let's do it. After all, who wouldn't want to know how far a football will go on the moon. But there is a logistical hitch to dispense with first. The spacesuit needed on the moon is too confining for throwing a football, so it will have to come off, leaving Brady only 15 seconds to live. Not a problem; he can wear a quick breakaway suit, and since his release is 2.5 seconds, we can get a good six data points before he ascends to the great gridiron in the sky.¹

I know Brady will go all in since he will then be able to throw a football farther than Aaron Rogers ever could, and it will add to his already sizeable fifty-four NFL records. He'd gladly use his last fifteen seconds for that. After all, he's not called the GOAT for nothing. Though I think the monkey wrench in all of this will be Gisele; it'd be just like her to object. And his agent too. But I bet Bill Belichick would give a thumbs up. Now, there's a guy who sees the big picture.

Okay, forget strapping Brady to an Atlas rocket. There's another way. We can find the answer by building a mathematical model that includes the physics of Brady throwing a football. We can model gravity pulling down on the football, air resistance (on Earth) slowing it down, his release angle and velocity, the weight and size of the football, and the forces acting on the football.

Which is what I did. The following figure shows the football trajectory after his release on the moon and, for comparison, in Tampa Bay. He will throw the football about 500 yards, with a hang time of twenty-four seconds, reaching a height of 127 yards. Take that, Aaron Rogers.



¹ Which direction is the great gridiron in the sky if he is starting from the moon? Isn't he already in the sky?

CHAPTER 8

Science doesn't Work the Way You Think it Should

A new scientific truth does not triumph by convincing its opponents . . . but rather because its opponents eventually die.

—Max Planck (1858–1947)

How would most people define science? From dictionary.com:

“Science is a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws.”

Which is no better than having a priest describe married life. It doesn't just miss the essence of science; it murders it with a brain-dead, bloodless definition that could take the buzz off a Grateful Dead concert.

Science is a human activity with all of its triumphs, failures, deceit, and heroism. It is as deplorable as the syphilis experiments carried out on black sharecroppers and as glorious as the Apollo space program. It is both noble and tragic, used to cure diseases and design gas chambers. And it is no more systematic than people are robots.

Certainly it deals with general laws and knowledge, but to say this defines science is to describe the Mona Lisa as consisting of paint.

Science is about people. Talented people, to be sure, but with their own Metabeliefs, dreams, quirks, and flaws that find their way into the science they do. This is not a judgment. It is simply the truth. It is how science gets done.

And it is Dr. Jekyll and Mr. Hyde in nature. On the one Dr. Jekyll hand, it is a well-defined and proven approach that has yielded advances and riches for us. On the other hand, Mr. Hyde is messy with warts, errors, limitations, and continual reversals. To understand science is to understand both.

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The Minimalist'S Guide To Science

Science has specific traits that set it apart from non-science; that was developed over many years, starting at least with Aristotle and hitting its stride in seventeenth- and eighteenth-century Europe. Galileo and his contemporaries chaperoned modern science pretty much the way it is today. Sure, we have better tools and more facts to work with, but the way science thinkers think about science hasn't changed since then.

Science works incrementally, building one layer at a time from past successful work. And while it may occasionally make great leaps, Einstein's theory of relativity or Newton's gravity, for instance, is still based on what came before. As Newton said, "If I have seen further than others, it is by standing on the shoulders of giants."

But first and foremost, science is about evidence and, more specifically, that which can be measured. In other words, hard, accurate, uncompromising data. Data is used to either support or falsify someone's idea on how some aspect of the universe operates. Reality is the final judge and executioner of any scientific idea.

Science certainly contains theories, analysis, computer simulations, and the like, but its one and only true master is data. All of the science lives and falls by it. If you cannot measure it, it's not science. It might be proto-science, philosophy, religion, opinion, politics, or even interesting, but not science.

This is not a trivial hair-splitting distinction. It is crucial to understand what science is, what it can do, what it can't do, and where we can be misled into believing lies dressed up in science's clothing. As sham science quickly descends into quackery and drinking bleach will cure autism and the earth is a flat pancake. Science banishes these. Trickery amplifies them precisely because it purposely avoids data that can validate or, more likely, falsify its claims.

Astrology is an example of a pastime that has both science and not even close to science aspects. It uses the planets' and stars' locations (science) to predict if we are finally going to meet that tall dark stranger. But where is the explanation of how the planets' alignment will predict our lives, and where is the data to support it? Neither exists, of course. It must be rejected as science and, therefore, as a truthful description of reality since no data exists to confirm it, yet much data exists to refute it.

A good comparison of science versus not science is evolution versus intelligent design. There is nothing wrong with either, but one is science and the other is not. Evolution is based on countless confirming facts, including fossil finds that show

CHAPTER 9

Nothing in Life Can Ever Be Certain. Nature Forbids It

“When you have eliminated the impossible, whatever remains, however improbable, must be the truth.”

—Mr. Spock quoting Sherlock Holmes

It’s true, we can only know the tiniest amount of reality’s secrets, as the previous chapter has shown. But Mother Nature, not content with stopping there, has decided that the little we can see will be through fogged-up lenses. Adding insult to injury, she puts a hard stop on how accurately we can know anything, which no amount of science advances can ever get around. I mean, if you’re pummeling someone, you might as go the whole nine yards. She’s a tough old biddy, that one.

The limit is not just because of our small cranial capacity, though that doesn’t help us any. It is also fundamental that all things can only be known with limited accuracy. For instance, flip a coin. We can never know if it will come up head or tails with certainty. We can only know that 50 percent of the time heads will show. And even that’s not certain.

The problem is that reality doesn’t itself know what it’s doing. Ask any electron orbiting any nucleus to tell you where it is at any given moment. It can’t. Not because electrons can’t speak but because it has no definite location, just a likelihood of being here or there or somewhere else. In other words, it isn’t anywhere at all, at least not in the sense of what location means to us. It is similar to the flipped coin, which can be in either of two states and we can never know which one it will be until we see it land.

Now multiply the electron’s confusion by all the other electrons orbiting every nucleus of every atom and it’s a wonder we even know our own names.

Uncertainty comes in two flavors. First is the plain vanilla kind due to our limited but growing knowledge and skills. There was a time when we didn’t know where diseases came from and ascribed it to divine punishment for our misdeeds. Then civil engineers came along and in the 1800s cleaned up the town’s water and

sewerage and people's health and mortality greatly improved. People still got sick, so we were still baffled until bacteria was discovered, and in 1928, penicillin to kill the bacteria. And now we are struggling to understand and defeat viruses. Continual progress but always uncertainty.

The second and more fundamental flavor is that reality is not deterministic and does not give the same answer to a question asked twice. This was first noticed by researchers when they probed the subatomic level and developed quantum mechanics to explain what they saw. And it has been confirmed by countless experiments. Reality is just a never-ending bundle of probabilities. We are certain of things only because we are ignorant of what we can't see.

So how can we be certain about uncertainty when nothing is allowed to be certain? Yeah, I'm as confused as you are. But we will make sense of it.

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CHAPTER 10

If the Military is Concerned, We Should Be Too

“It is the sense of Congress that climate change is a direct threat to the national security of the United States.”

—National Defense Authorization Act for Fiscal Year 2018

What if Russia destroyed our missile interceptors in Alaska, China disabled our radar installation on the Marshall Islands, and homegrown terrorists attacked the Norfolk Naval Shipyard? What odds would you give for that amount of havoc? I bet quite low. But if global warming replaces the aggressor in each of these examples, then the odds are not just high, but a sure thing. A sucker’s bet even.

The military knows this and their position is unmistakable as the Pentagon has stated:

“Climate change poses immediate risks to national security and will have broad and costly impacts on the way the US military carries out its missions”¹.

Consider that the military is tasked with protecting our country from outside enemies and have stated three pillars to accomplish this ²:

- Protect the homeland
- Build security globally
- Project power and win decisively

Sounds simple, perhaps, although not easy to accomplish with the large array of conventional and nonstate enemies squaring off against us. But now U.S. armed forces are also facing global warming, an additional enemy with an arsenal vaster than all of the above combined. For instance, according to NASA, a hurricane will release the energy of ten thousand nuclear bombs during its life cycle ³. Not big enough for you? Global warming is making them much more powerful still.

Global warming is a threat no different than Russia, China, or terrorists, homegrown or not. The result is certainly the same. Global warming will cause

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destruction, casualties, and economic decline, similar to an attack, with the only real difference being global warming will take a bit longer to achieve it.

And while the military's budget is substantial, it is not unlimited, which compels them to use their resources with little wasted motion. But global warming is forcing this substantial, but limited, budget to be spread thinner, taking assets away from their known and traditional adversaries. It's a zero-sum game. If you move some assets from here to there, you then have fewer assets here.

The military would never squander precious resources any more than a hoarder would give up their years of accumulated newspapers. So if the military is moving money from their typical threats, we can be sure they believe global warming is real and menacing. And if they believe it, so should we.

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Part IV. The Final Verdict

Finally, part IV explains how bad our climate crisis is and what we must do to solve it.

CHAPTER 11

So How Bad is It?

“The clock is really ticking now. It is getting loud.”

—Night School, Lee Child

It’s not good. We have already increased our global average temperature by 1.8°F and are committed to at least another 1°F.

And the further it goes, the more likely bad things will happen. It’s no different than putting on too much weight. A little is okay, but as we go from overweight to obese, the more likely diabetes and other diseases will strike, and the more serious they will be. And now we’re at an all-you-can-eat buffet. Our System 2 is telling us no, while System 1 is rushing to the head of the line. That pretty much sums up our addiction to fossil fuels; an assault on our planet for instant indulgence.

Sure, we need energy. We can’t live without it, just as we can’t live without food. But must it be fossil fuels? Just as we need healthy foods, we also need healthy energy.

We’re slowly getting there. But slow and steady will not win this race. Only a sprinting hare will.

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Tipping Points

Bounce on the edge of an Olympic pool diving board. So far, so good. But lean a little too far forward, and you will slip off the edge, and there is nothing you can do to stop your fall. Nothing in heaven or on earth can. You are going to plummet eighty-nine feet into the water. You passed a tipping point.

Global warming also has tipping points. They occur when our environment takes a sudden and unexpected turn for the worse. Once it happens, it can't be reversed. At least not in the next few generations. And that's not the worst of it. It may grab some other tipping points and take them down with it.

Some examples ¹:

1. Polar and Greenland ice disintegration—Melting ice decreases the amount of sunlight reflected back into space, resulting in a spiral of higher temperatures which leads to more ice melting and, therefore, higher temperatures and so on. Like a dog chasing its tail, it never ends until all the ice is gone.
2. Rainforest diebacks—The amount of CO₂ the Amazon forests can store has been steadily declining because trees are being lost from intentional clearing and from fires. As global warming temperatures increase, more trees are lost, so less CO₂ can be captured, so temperatures go higher still. Another unfortunate spiral. Eventually, the rain forests will be unable to regenerate and will turn into grasslands and will never come back. A global temperature rise of 7°F may do it.
3. Permafrost thawing will release methane—The permafrost is melting, and it may release slugs of methane that have the potential to more than double the greenhouse gases now in our air. If it blows, the effect will be catastrophic. A global warming temperature increase of about 9°F will make this more likely.
4. Ocean acidification—As the oceans continue absorbing CO₂, their acidity increases and their oxygen storage goes down, leading to massive fish die-offs, which would put further pressure on an already precarious food supply.
5. The Atlantic Meridional Overturning Circulation (AMOC) is disrupted—The AMOC is a large ocean current that moves northward, transferring tropical heat and moderating the northern hemisphere's climate. But water from melting ice threatens to weaken this flow and could suddenly halt it altogether, leading to extreme weather conditions. For instance, it could seriously reduce Britain's rainfall and destroy its farming industry. A global temperature rise of 7°F makes this more likely.

Tipping points are closing in fast. It could get ugly.

CHAPTER 12

Can Anything Be Done, or is It Game Over?

“The difficulty is to persuade the human race to acquiesce in its own survival.”

—Bertrand Russell

A doctor prescribes meds to break a life-threatening fever. I think we would gladly and thankfully take the pills.

This is pretty much what the IPCC has told us ¹. Our planet has a fever, and it has already warmed by 1°C (1.8°F)ⁱ due to global warming and will climb by another ½°C (1°F) somewhere between 2030 and 2050 if we don’t take action. And the consequences could be dire, with monster storms, droughts, food shortages, increased violence, and much more. So to avoid the worst, we must completely eliminate our greenhouse gases by 2050.

The medicine we need takes two different approaches, both necessary.

The first is obvious. We need to install equipment and take other actions that will reduce and eliminate greenhouse gases to stop this relentless global temperature rise. Some are ready to go, some need development, and still, others need considerable development.

But not just any equipment. No, there is an unfortunate rub to this. The IPCC has put a hard stop at the year 2050 to decarbonize our planet so as to avoid the worst of what global warming has to throw at us. And this deadline must factor into our decisions. We need to drive the technologies that are more likely to be widely deployed by then. That’s not to say we should avoid longer-term ones, but rather we should be putting most of our efforts and resources into those that can get to us before the 2050 window closes.

The IPCC deadline also means we need to get serious now not later. Our way of living has always been, “Why do something today if I can put it off till tomorrow?” That must cease. It must be “Do it today, do it right, and do it quickly.”

ⁱ Compared to the average temperature measured between 1850 and 1900.

And now is not the time to pick winners based on political or personal agendas or financial gain, which, unfortunately, I have seen. For instance, there's the renewables camp which dismisses nuclear as having too many disadvantages. Then there are the nuclear proponents who claim renewables can never get us far enough. I've run across the carbon tax zealots who believe it to be a new religion we must all bow down to. Each thinks theirs, and theirs alone, must be pursued. We cannot pick a single approach. Risky business that. We need them all, and at this point we can't predict which will work well enough to be part of the mix. Some are not going to work. That's okay. Discard them. Move on.

The second path is less obvious but just as important. We need to take control of the problem as individuals, and as part of the groups we belong to and be sure those representing us do the right thing. We need strong leadership, and we must give them our complete support to solve an ominous civilization-wide problem. And if they don't, then we must replace them. We must cut through the foolishness that so often accompanies emotional issues. That is squarely on our shoulders and to fail at this is to fail our nation and our children.

We are not going to make it all the way to the IPCC goal by 2050; there's just not enough time, resources, and will. But we must get as close to it as we can so we can pull ourselves back from the cliff's edge when the technology and social issues catch up.

It is not going to be easy. But it is possible and it is very much necessary.

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CHAPTER 13

Beyond a Reasonable Doubt

Ladies and gentlemen of the jury:

The fate of our planet rests in your hands. Take a deep breath and let that sink in for a minute. It's a heavy burden, I know. Global warming's unchecked rampage has already killed many thousands and has caused billions of dollars in damage. And it is just getting warmed up, so to speak. Your job is to decide whether its assault is real and, more importantly, what's to be done about it.

Let's review the evidence.

First, the murder weapon. Greenhouse gases, mostly CO₂, have been spewing from the fuels burned in homes, autos, factories, and airplanes. CO₂ has relentlessly altered our air, disrupting the beautiful balance between our planet and the life-giving sun that warms us. It has caused more heat to hit our planet than the planet is capable of removing. What happens when you raise your thermostat setting? The temperature goes up. It gets hotter. And so it has with our world.

This has produced giant storms, melting glaciers, raising sea levels, and extinctions seen only five times in the past 300 million years.

Next, the motive. We have been on an energy-rich diet since the Industrial Revolution, and it has propelled our society to a lifestyle never experienced, maybe never dreamed of, by our ancestors. All in all, it has done well by us. But it has gone too far in its insatiable drive for wealth, discarding our well-being for the addictive need for more wealth and still more after that. Now it is sacrificing our planet, us, and our children for that unreachable itch.

Finally, there was ample opportunity. Since the 1700s, we have been putting CO₂ into the air in ever-increasing amounts. Burning fuels was slow at first, but now it's more like a ruptured fire hose, and CO₂ has gone from 280 ppm to over 400 ppm in a blink of an eye. Never in the history of civilization, and 3 million years before then, have we put so much evil into our breathable air so quickly.

I've shown you the co-conspirators. The energy company shape shifters that provide the fossil fuels while hiding their true character—one of greed and power. Just like the tobacco companies before them, they have expertly distorted the truth, blinding us from seeing the cliff we are rushing toward.

And let's not forget the enablers; the deniers and denizens of social media, who are eager to betray us for a few pieces of silver and website clicks. Those with large followings who will readily sacrifice our children's future for their padded bank accounts, fast cars, and large houses.

You have seen how they weaponized lies to stop us from seeing the painful facts of global warming. To them, truth's destruction is acceptable collateral damage. In fact, it is preferable since it is a game of control as much as anything. Control us, so we don't swallow the red pill and see them as they truly are.

I've shown you how to get past their bluster, the smoke and mirrors, the outright lies, the street muggings of our reason. You are well-armed to judge the truth. It's not difficult. It just takes a few tools that you now possess and some critical thinking.

When you consider all of this, ask yourselves a simple question. How can nearly every climate scientist be convinced of global warming's harm if it is not so? Let the answer guide your deliberations.

I know you will agree the evidence is overwhelming and cannot be denied by any rational person.

I now ask you to return a guilty verdict of crimes against humanity. Guilty of polluting our air and wrecking our home planet. Doing it willfully with intent and malice. And causing harm to all of us.

But I also ask you to temper your verdict with compassion and mercy. Sure, it has been known as far back as 1896 that CO₂ is a greenhouse gas and as deadly as a coiled viper ready to strike. But how could anyone have guessed the serious threat it was? We were on a giddy rocket ascent of wealth and advancement with no time to consider the consequences.

But even compassion and mercy have limits. The guilty must reform and must follow a path clearly laid out, difficult perhaps, but not impossible. We can solve global warming but only if everyone agrees to do so.

You must judge the guilt and what should be done. But remember, you are not just the jurors. You are also the victims. And the accused.

Choose wisely.

The Prosecution rests.

EPILOGUE

Albert Calabrese jumped into the Ardennes Forest with the 82nd Airborne in 1944. At 23, he was tough and brutal though a bit naïve. As soon as he shed his harness, an enemy soldier charged at him. Thinking it was a joke, he smiled and put up his hand in mock defense. As I said, Calabrese was naïve. His hand deflected an onrushing bayonet, saving his life.

Calabrese fought his way through Europe earning a Bronze Star, two Purple Hearts, battle ribbons, and commemorative cords from Belgium and Norway.

And while the 82nd Airborne were special soldiers, maybe the most special; in many ways, Calabrese was no different than the millions of other men and women in the war and at home who shaped the U.S. into an economic and political powerhouse, the likes of which had never been seen before. As Shakespeare might have said, they may not have been born great, but they achieved greatness whether it was thrust upon them or not. And 75 years later, we are still reaping the rewards of their sacrifices and accomplishments.

Now it is our turn. We are in a similar position where global warming problems have been thrust upon us and threaten our well-being, indeed our very existence. Storms, rising sea levels, famine, violence, and intolerable heat are all attacking us on multiple fronts. And once again, we are in a fight for our lives.

What we do now will affect our nation and our world more so than at any time in humanity's brief existence. But look. Calabrese did it and he was just a green kid coming off the streets of Brooklyn. He was nothing special. At least not until he stepped through that door and hurtled toward the ground. That one step took him from an unremarkable placid life and into the history books.

I realize the responsibility we are now burdened with is causing us much angst and fear. But that load also brings an opportunity, few in history are fortunate enough to be a part of it. Remember, saving ourselves, our children, and all the generations coming after us will forever be celebrated with admiration and relief. Relief that the coming generations were spared from the worse of global warming, allowing them to accomplish unimaginable breakthroughs that will push humanity to newer and higher plateaus. And we will be the reason they could.

Just as Calabrese and his brethren knew they would emerge victorious, so will us.

Of this I am certain.

It is now our time to step through the door.

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