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## When Worlds Collapse

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*Every man takes the limits of his own field of vision for the limits of the world.*

– Arthur Schopenhauer

*Faster, faster, until the thrill of speed overcomes the fear of death.*

– Hunter S. Thompson

At the vulnerable age of 19, I read a small paperback book called *The Limits to Growth*. No other book would influence my life so greatly, though I could barely understand its message at the time. Had I been able to comprehend it thoroughly, I might have laid down my head in the library and wept. At the same time, if I had been granted a vision of where my interest in the book and its central message would ultimately take me, I would have been overcome with amazement.

*The Limits to Growth* deserves a place on the list of the most controversial books of the 20th century, right up there with James Joyce's *Ulysses*, Madonna's *Sex* and Salman Rushdie's *The Satanic Verses*. Its publication in 1972 ignited a firestorm of international discussion and debate.<sup>1</sup> The book's authors – Donella ('Dana') Meadows, Dennis Meadows, Jørgen Randers and William H. Behrens III, with Dana as the principal writer – were part of a young team of scientists (average age 26) from the Massachusetts Institute of Technology. They had spent two years programming a computer to act as a model of the entire world. The future of that simulated world – they called it 'World3' because it was the third in a series of attempts to create a global computer model – did not look good. In scenario after scenario, when humanity's wildly accelerating growth in population, resource use and pollution was left unchecked, World3 collapsed. No simulated improvements in technology could prevent simulated catastrophe. Humanity's swelling billions would consistently overshoot Planet Earth's capacity to feed, support and employ them. Then they would start dying off, as their agriculture began to fail and their industrial production crashed. Without decisive action to bring growth under control, and quickly, collapse always came within 100 simulated years.

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That word ‘collapse’ gives the impression of suddenness and finality, but these researchers were predicting neither a sudden nor final apocalypse. In fact, they were not predicting anything at all. They were simply analysing the existing trends, programming the computer to project the way these trends (in areas like population growth, industrial waste and food supply) would interact in the future, and reporting on what would happen if humanity did not change course. The statistical collapse that consistently occurred was more like a swift slide than a mad plummet, more swan-dive than cannonball. The little line on the graph representing human population would keep rocketing up until it reached the stratospheric level of 12 or 15 billion people, then it would turn over and start heading down to ground zero just as rapidly. The same thing happened to the lines for food production and industrial output. There was an odd gracefulness to the shape of the curves coming out of the computer, an eerie mathematical beauty that masked the horror of their meaning.

It is mercifully difficult to imagine living through a global collapse of the kind portrayed by World3’s symbolic line graphs. Over the course of a generation, some combination of horrific disasters – famine, disease, widespread slow-motion poisoning caused by pollution, vicious wars fought over dwindling resources by unemployed and desperate young men, and, last but not least, astonishing natural disasters fuelled by climate change – would combine to kill off quite a few billion people. Nothing remotely like this has ever happened to humanity on the global scale. The closest examples might be the Black Death plague in medieval Europe, or the mind-numbing carnage of the 20th century’s world wars, but even these were limited in scope, mere circus sideshows by comparison.

And that’s just the fate of humanity. Although World3 did not overly concern itself with the ultimate effects on Nature and its web of complex ecosystems, one can easily discern, reading between the lines on the old printouts, the eventual collapse of biodiversity and ecosystems as well. A world full of desperate and impoverished people is a world emptied of swordfish, rainforests and panda bears. A collapse, if it occurred, would take so many species with it that Nature would have to spend 5 to 10 million years rebuilding its storehouse of diversity.

And yet, life would go on. There would still be humans and other species, albeit far fewer of both. ‘Collapse’ does not mean the end of the world, the end of Nature or the end of anything, really, except perhaps the comforts of industrial civilization, together with thousands of species, billions of people’s lives and humanity’s collective innocence about three fundamental laws of Nature. First, when it comes to population growth (for any species, not just humans), what goes up exponentially must stabilize, or it will crash down. Second, with regard to forests, fish and other

resources, what gets used too rapidly and too thoughtlessly will ultimately cease to exist. And finally, as for waste and pollution, what gets dumped – into the water, land or air – spreads out, hangs around and creates havoc for generations to come.

None of these are desirable outcomes for the human project known as civilization. Yet these are the terrors consistently produced by World3, given certain assumptions about where the real world had been and where it was currently headed.

World3, its creators knew, was flawed. There were certain to be gaps of knowledge, errors of calculation, problems of interpretation. Estimates made to fill holes in the data were probably inaccurate. But since the whole point was to imitate, as closely as possible, the likely behaviour of the real world, the consistent *pattern* of the model's results – rapid growth to the point of overshoot, followed by collapse – was rather disturbing. It almost didn't matter whether the inevitable estimates were optimistic or pessimistic: collapse was the perennial outcome. Prodded by their funders, the World3 creators began to feel they had an important message to deliver. Aided by a generous promotional budget and savvy media work, the image of a computer pronouncing on humanity's fate made big headlines. Unfortunately, the message was garbled in the transmission.



The authors of *The Limits to Growth* did not think of themselves as prophets. They were just hotshot academics playing with a new toy in a new field: computer-based models of dynamic systems. They had plenty of backing from a prominent internationalist forum known as the Club of Rome and from the Volkswagen Foundation. They were protégés of Jay Forrester, the brilliant founder of their new science, and they had done their mentor proud by taking his breakthrough ideas about stocks and flows, feedbacks and delays, and creating the most ambitious mathematical copy of the world that anyone had ever seen.

To accomplish this, they built smaller models of subsystems of the world – population, agriculture, resources, industrial production and pollution – and then linked them together. The object was to see how various trends affected each other: how rising pollution levels, say, might eventually speed up death rates, and how that in turn might affect the food supply. World3 was an attempt to mimic, using differential equations and feedback loops, the famous dictum of John Muir that ‘everything is hitched to everything else in the universe’.

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The real world – let's call it the World – is far more complex than World3, or any of its successors. The World consists of systems within systems within systems. It also includes such wild-card elements as political scandals, breakthrough inventions and renegade dictators. The World includes the beauty of Mozart and fine architecture and the Bolshoi Ballet, as well as the tawdriness of a casino on a slow Monday night. The World is more than just people, culture, machinery and the movements of capital, though it includes all of those, together with human qualities like courage and vanity and greed. The World, to dig deeply into its origins in Old English, is 'the age of man'. Or, since 'man' is thought to be an old word for 'consciousness', the World is 'the age of consciousness'. No one could presume to build a model of *that*.

But the beauty of World3 lies in the mathematics. Barring cosmic intervention, a population growing at 2 per cent per year always doubles in 36 years, unless something happens to change that growth rate. This is undeniably, unalterably true, whether it happens in World3 or in the World – or on Mars, for that matter. So a computer model like World3 cannot be discounted simply for being a model,<sup>2</sup> because mathematics is the link between the computerized fiction and the flesh-and-blood reality. Mathematics makes the rules in both Worlds. The computer simply automates the task of calculating numbers, while compressing time: in World3 (and its successors), you can watch a hundred years flash by in a few seconds. In the World, a hundred years takes a hundred real years – and if you don't like what happens, you can't push 'Reset' and start over. In World3, numbers representing human populations go up and down, just as they do in the real World, but without the attached drama of real human lives, with all their joys and sorrows. The potential avoidance of foreseeable, real sorrows is what makes World3 worth contemplating.

What happens in World3 is not exactly a forecast; it is, you might say, a parallel reality. In that alternate reality, the unrestrained expansion of people and their stuff makes everything go haywire, and civilization collapses sometime in the middle of the 21st century. Does that mean the real World is doomed to the same fate? Not necessarily. Unlike the virtual citizens of World3, real human beings have the power to become aware of danger and to change course in order to avoid it. Our World is, after all, 'the age of consciousness', a feature decidedly lacking in the computerized version.

But despite its toy-truck qualities, World3 teaches us something of devastating importance: if unrestrained growth continues in the real World, a future collapse is certainly possible, and may be inevitable. The mathematics of growth are driving us ever more rapidly beyond the limits

of the Earth's capacity to provide resources and absorb wastes; but it is still not too late to change course, draw down, pull back from the brink. There are enormous challenges to be overcome, but we can overcome them, so long as we exercise that distinguished quality of consciousness to its fullest extent. It's a question of choice.

This was the message that the young authors of *The Limits to Growth* began trying to deliver in 1972. They were seriously and politely received into the halls of power, and their message was echoed around the World via the media. Their arguments were considered by some of the greatest minds of the day. Many, especially those in the Club of Rome, praised and publicized their work. But the young authors were quite naive about the ways of power, politics and publicity. They mistook open doors and smiling faces for acceptance, and it came as a rude surprise when they were viciously attacked by their peers, their work was vilified in the American press and, most painfully, their message was subsequently ignored.

Today, we live in a World of swelling populations concentrated in the poorest regions, disappearing fish and freshwater resources, declining food production per capita, global financial turmoil, increasingly desperate migration (often caused by natural or environmental disaster), rising conflict over land and resources, toxic pollution affecting nearly every living organism, and a dangerously changing climate caused by the ever-increasing emissions from our cars, power plants and factories. 'Growth', meaning the number of human beings and how much stuff they use up and discard, shows a few modest signs of slowing down, but at nothing like the pace required to avert far worse catastrophes than the ones already being suffered by the poorest and most vulnerable in places such as Bangladesh, Honduras and the Maldives. We are not yet living in the global collapse envisioned by World3, but some of that computer model's downward-plunging curves are beginning to look frighteningly similar to patterns in some parts of the World, and to our own possible and increasingly probable future. In some areas, including climate, we appear to have already passed the point of no return; we can no longer prevent some of the changes we have already set in motion, and must direct our efforts to adapting to those changes, while also striving for the restoration of stability in natural systems.

But according to the common wisdom among people who still vaguely remember it, *The Limits to Growth* was a provocative but flawed book whose 'predictions' turned out to be 'wrong'.



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*Carmel, California*

*Late summer 1981*

*I am driving with my friend Martin down the coast to visit Ansel Adams's house. The great nature photographer won't be home, but his assistant is an old friend of Martin's. We'll have the run of the place.*

*Martin was one of my professors in college, and he taught a course in Ecoscience that made a huge impression on me. He was an odd duck – always wore short pants and suspenders, and talked with a slight, inauthentic British accent – but he was passionate about this topic. We read books on population, ecology and the growing impact of technology on the environment. We read *The Limits to Growth* and *Small is Beautiful*.*

*That's why I'm having such a hard time understanding why Martin, a geologist, has now gone to work for an oil company, helping them to find new deposits of fossil fuel.*

*On arrival, Ansel's actual house proves to be a bit dull – very few of his famous black-and-white landscapes are in evidence – but then John, the assistant, takes us down to the cove. This isn't just any spectacular cove on the Carmel coast; this is Ansel's cove. He owns it. I'm not sure if that means he also owns the seal that pokes its head up out of the kelp and stares at us, but the sight of it makes John's dog, an Irish setter, go berserk. He dives in and swims out toward the seal, barking wildly.*

*When the dog gets within about ten feet of the seal, the little rubbery head disappears. It pops up moments later about 30 feet behind the dog, and gives a mocking bark of its own. So the dog turns and ploughs through the kelp toward his aquatic cousin. It's a losing game, repeated over and over. The seal is just toying with him.*

*As we watch these canine antics, I ask Martin about his oil company job. How could he do it, given what he knows, given the passion for the environment he used to have? 'It's easy', he answers, shrugging. 'I needed the money'. He goes on to explain that this company isn't as bad as the others, and if he didn't do it, somebody else would do the work anyway; but I have a hard time listening.*

*The dog has given up. Exhausted, it swims to the shore, turns and stares at the spot where the seal has finally disappeared for good. In the gathering dusk, the cove looks like one of Ansel's photographs, which it probably is. The dog issues one final, plaintive bark; the sound seems to hang there amid the reflections and shadows. By the time we get home, it is dark.*



Like most ideas that attain the status of myth, the notion that ‘growth equals progress’ was founded on a considerable amount of truth. Most of the great technical and cultural advances of the past several millennia – from medicine to symphonies to satellite weather forecasting – were made possible by the steady increase in economic activity of all kinds. Progress in the arts and sciences has always been fuelled by economic surplus, and often by concentrations of wealth in the hands of a relatively enlightened nobility or merchant class.

It is a simple matter of arithmetic. If everyone must work all the time just to survive, there is no time left for scientific discovery or creative endeavour. Growth – of people, machines and overall wealth per capita – allows the World to allocate more time to activities that are not essential for survival. This scheme works at every level, from small scale to large. When you increase your personal income, for example, you can afford to allocate more time to leisure and personal interests. The larger and more profitable a company grows, the more time and money it has to invest in research and development. As a community or city grows richer, it can afford better amenities, such as libraries, theatres and stadiums.

And in society at large, growth in the economic sphere permits investment in new technology, higher levels of education and even (hope springs eternal) better government. The fewer the number of people required to labour in the fields and factories, the greater the number who can pursue education, new ideas, public service and personal passions.

It is a beautiful scheme, and it works – up to a point. That point is a wall comprised of the laws of physics, the principles of mathematics and the limits of natural systems. Beyond that point, as the old maps used to say, ‘there be dragons’.



When *The Limits to Growth* hit the World in 1972, Dennis and Donella Meadows – then married, later amicably divorced – were still in their early 30s. They had spent the last two years working on the computer modelling project that would eventually make them modestly famous. The project was, at first, just something fascinating to do.<sup>3</sup> ‘We didn’t even think about trying to change the world,’ said Donella (who will be referred to by her nickname ‘Dana’ for the remainder of this book). ‘We were just trying to make a good computer model.’

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After they had presented their preliminary technical results to a range of audiences, from fellow scientists to United Nations bureaucrats, and received mixed reviews, Dana had a realization. 'There needed to be a little popular book that communicated the central idea in a way that the average reader could understand, without all the computerese and scientific jargon. And the central message was about growth and limits.' She set to work on the 'popular' book, and fought unsuccessfully with her colleagues and co-authors to keep the computer model totally out of it. In the end, it was the *inclusion* of the computer model that most captured the public imagination, and that – combined with the chilling message about the possible fate of humanity – propelled the book to the bestseller list.

The Meadowses foresaw none of this. Their ambitions for the book were modest and academic until they received a call from the soon-to-be US publishers of *The Limits to Growth*, a small outfit called Potomac Associates, who said they were arranging to present a copy to every senator, representative, governor and UN ambassador. It was also organizing a formal presentation and seminar at the Smithsonian Institution, which many of the most powerful people in Washington, DC were expected to attend. 'From that moment, everything changed', Dana recalled. 'We realized that people were actually going to take notice.' The leak of an early manuscript to *Time* magazine, which immediately published a grim, doomsday article about their research, underscored the fact that they had a tiger by the tail: 'It was out of our hands at that point', she told me. 'It was something bigger than we could control. All we could do was show up and try to do a good job.'

The event in Washington lived up to the publisher's advance billing. Attendees included chief justice of the Supreme Court Earl Warren; Dr Philip Handler, president of the National Academy of Sciences; Dr Wernher von Braun, known as the 'father of the space age'; and a long list of ambassadors and leading intellectuals. Elliot Richardson, who was secretary of Health, Education and Welfare under President Richard Nixon, spoke sombrely of the book's critical importance. And the press echoed the book's message – or a simplified version of it – in headlines all over the US and the world.

'MANKIND WARNED TO CURB GROWTH OR FACE CATASTROPHE', said the *Chicago Sun Times*. 'PANEL ON GROWTH STRIVES TO STAVE OFF WORLD RUIN', said Virginia's *Newport News*. 'WILL GROWTH KILL HUMANITY?', asked the *Tampa Tribune*, adding 'IS "HOW SOON" THE ISSUE?' News reports were supplemented by opinion pieces in the *New York Times*, the *Washington Post* and many other papers. To look back at these articles is to feel nostalgia for



the days when newspapers took seriously their responsibility to educate the public.

The prominent *New York Times* columnist Anthony Lewis, for example, wrote four columns about *The Limits to Growth* in 1972, two before the book's publication (titled 'To Grow and To Die', I and II) and two after ('Ecology and Economics', I and II). He declared that *Limits* was likely to become 'one of the most important documents of our age', and he took great pains to explain the dangerous dynamics of exponential growth.

*The crucial fact is that growth tends to be exponential. That is, it **multiplies**. Instead of adding a given amount every so often, say 1,000 tons or dollars a year, the factors **double** at fixed intervals. That tends to be true of population, or industrial production, or pollution, and of demand on natural resources – some of the main strains of planetary life. [Emphasis added]*

It is hard to imagine such an instructive paragraph showing up in *USA Today*. After noting that 1972's population growth rate of 2.1 per cent equated to a doubling of population in just 33 years, Lewis went on to explain why exponential growth is so hard to fathom:

*Exponential growth is a tricky affair. It gives us the illusion for a long time that things are going slowly; then suddenly it speeds up. Suppose the demand for some raw material is two tons this year and doubles every year. Over the next fifteen years it will rise to only 32,768 tons, but **just five years later it will be 1,048,576 tons**.*

*That phenomenon is what makes it so hard for people to understand how rapidly we may be approaching the limits of growth. [Emphasis added]*

*Washington Post* columnist Claire Sterling did a similar public service in explaining what the authors meant by collapse:

*The crisis level comes when growth has gone too far: too many people taking up too much of the land that ought to be producing their food, demanding too many manufactured objects using up too many raw materials and polluting too much of our land, air, and water. When this happens, growth stops, either because people starve to death, or raw materials give out, or pollution surpasses livable limits, or the stresses of overcrowding provoke war. World population could then drop by as much as a fifth in a single*

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*generation, while the bottom drops out of life as we know it for the rest of us.*

The computer, said Sterling, is primitive, 'Nevertheless, it seems able to grasp more than we do.'

On the critical issue of time, which was a topic misunderstood by most reviewers, Ross Gelbspan – who now writes eloquently on climate change, but who was already, in 1972, writing in a similar vein for New York City's *Village Voice* – did an excellent job of interpreting (and emphasizing) *Limits'* essential warning. He noted that the immutable mathematical laws of exponential growth meant that '*after about 1985 it will be too late to reverse the final stage of exponential growth which will cause the collapse of natural and social life-support systems.* But the actual impact will not be totally felt until the mid-twenty first century' [emphasis original].

In one of several articles concerning the book, *Time* magazine described it as written in 'restrained, nonhysterical, at times almost apologetic language', and noted with sadness that 'the study closes almost every escape hatch'. Technology would solve the resources problem only to exacerbate the pollution problem. Efficiency could reduce pollution, but that wouldn't stop population growth from running rampant and using up all the land for growing food. 'There is only one way out', says the report, 'economic as well as population growth must be stopped cold some time between 1975 and 1990 by holding world investment in new plant and machinery equal to the rate at which physical capital wears out.'

But as we all know, the human economy did not stop growing by 1990. Indeed, growth was just then hitting its stride. As a result, we have committed the World to global warming, a depleted ozone layer, water shortages, species extinctions, hormone-mimicking chemicals filtering through Nature for decades to come and many other irreversible changes. *Time's* summary proved prescient: technology did solve the resources problem for the moment with ever-better extraction techniques – which, in turn, has worsened the pollution problem. Efficiency and clean-up technologies did make it possible to reduce emissions of various kinds – but growth in population and affluence erased many of those gains while increasing unforeseen forms of pollution such as greenhouse gases and ozone-layer destroyers. And in recent years, population growth – propelled by earlier advances in food production, medical care and economic development – has begun to outpace the growth in food production, even as the amount of land available for growing food declines.

It is no wonder, then, that when the authors of *The Limits to Growth* updated their findings 20 years later in 1992, they called the second edition *Beyond the Limits*.



In retrospect, it seems foolhardy to hope that a book could turn the tide of civilization. But *The Limits to Growth* was an international phenomenon. Dana and Dennis began to believe that the World could indeed be changed. ‘We were received politely wherever we went’, recalls Dana. ‘It lasted about two weeks. Then the big guns came out.’

The ‘big guns’ were a small army of prominent economists, scientists and political figures who took aim at *Limits* from all sides. They attacked the methodology, the computer, the conclusions, the rhetoric and the people behind the project. The book’s authors found themselves on an intellectual hotseat, like doctoral candidates defending their thesis before a hostile committee comprised of the World’s loudest and most powerful voices.

Dennis Meadows, who served as the primary spokesman, accepted an invitation to debate Yale economist Henry C. Wallich before the American Society of Newspaper Editors. As soberly as he could, Dennis offered them his analysis that ‘the planet’s population will double in thirty years if unchecked, creating intolerable problems of pollution, economic distress, and conflict over dwindling supplies of income and resources’. He went on to say that ‘this growth cannot go on forever’, and that ‘the decisions must be made soon’ to slow down population growth and the increase in resource use and pollution that come along with it.

Wallich retorted that the World ‘could hardly make a more important – and, to my mind, more misguided – decision’ than to follow Meadows’s advice. Wallich agreed that present growth rates could not go on forever, but he said the World would simply stop growing naturally. ‘Even if the ceiling on growth were much lower than it appears’, said Wallich, alluding to his belief that the Meadowses’ hundred-year scenario was far too pessimistic, ‘the world, with a minimum of good management, could level off without the collapse he predicts.’

By stopping growth too soon, Wallich warned, the World would be consigning billions to permanent poverty. Technology could solve all the problems Meadows was concerned about, but only if growth continued apace. ‘What I am proposing’, said Wallich, providing a foretaste of many future policy debates, ‘is a voluntary approach that will allow us as much growth as our resources and our environment can support, and that at some future time, probably in the very far future, will gently ease our descendants into a phase of slower and, eventually perhaps, zero growth.’

Wallich’s arguments – emphasized even more strongly by other economists such as Julian Simon – were polite in comparison with broadsides

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launched against *Limits* in the press. A typical blistering review came from economist Peter Passell and others, writing in the *New York Times Book Review*. They dismissed the book as ‘an empty and misleading work ... less a pseudoscience and little more than polemical fiction’, and smelling of ‘technical chicanery’. They also ridiculed the Meadowses’ method of extrapolating current trends into the future: ‘as British editor Norman Macrae has observed, an extrapolation of the trends of the 1880s would show today’s cities buried under horse manure’. In fact, the authors of *Limits* had *not* simply extrapolated, but some reviewers did not let their ignorance of how the model was constructed prevent them from attacking it.

These and other more technical critiques, including a devastating review in the prominent journal *Science*, gave Dana, Dennis and their colleagues a rude awakening. ‘It hurt most’, says Dana, ‘to be dismissed by our scientific peers.’ But perhaps the most distressing and revealing rebuke came from Russell Baker, the widely read *New York Times* humorist and columnist. Baker had attended the Smithsonian affair and he came away unmoved. ‘How typical, how depressing’, he wrote in a piece called ‘The Machine, the Doom and the Fool’, ‘that most of us, dependent upon a computer and a mathematical model for news of doomsday’s imminence, don’t even know what a mathematical model is, or what a computer does with it, or to it, or at it.’

Elliot Richardson, another Smithsonian attendee and panellist, had listened to the presentation made by Dennis Meadows and commented that, faced with such information, ‘the mind boggles’. But after reporting this, Russell Baker noted wryly that ‘the mind stops boggling very soon, absorbs the fact – “Yes, the world really is coming to an end this time” – and resumes functioning on the old ante-doomsday assumption that everything is going to come out all right in the end’.

Most of the World seemed to respond to *Limits* much as Russell Baker did. At the same Smithsonian event, the boggled Elliot Richardson offered a rationale for inaction that was at once insightful and self-serving. ‘The minds of the people’, he declared, ‘are unprepared to accept the political leadership that these conclusions would compel.’



Seeking to understand how so many thoughtful people could have responded so strongly to *The Limits to Growth* only to have the book soon disappear from the public consciousness, I called up Anthony Lewis of the *New York Times* in early 1999 (Lewis, a Pulitzer Prize winner, was still

an active columnist then). His four columns did not exactly spring back to his mind. 'If you expect me to remember something I wrote in 1972, I'm afraid you'll be gravely disappointed,' said the congenial Lewis. But he did remember *The Limits to Growth*. 'The book had a great impact on me', recalled Lewis, 'because I was already sensitized to the issues of population and the environment.' Asked what sensitized him, Lewis sang a little verse from Gilbert and Sullivan's *Iolanthe* to me over the phone, complete with instrumental fills. The song explained, with typical verve,

*how every boy and every gal  
born into this world alive  
is either a little liber-al  
or else a little conserva-tive...*

If Lewis's liberal leanings made him open to the message of *The Limits to Growth* when it was published in 1972, what did he think about the message now? Lewis professed a certain relief that 'the criers of havoc turned out to be wrong. We're still here, and we didn't run out of resources.' I pressed him gently. Were they completely wrong, or had they been misinterpreted, or perhaps premature, in their predictions? 'You mean, like premature anti-fascism?' he said chuckling, probably referring to the partisans of the Lincoln Brigade in the Spanish Civil War, who had been accused in the US of fighting the rise of totalitarianism 'prematurely'. 'Well, they were wrong in a certain respect. They greatly underestimated the adaptability of our technological society to substitute for materials – Julian Simon turned out to be right on that score. But I think that the psychological and economic effects of population growth and overcrowding are real. Take a look at Africa.'

I wasn't sure I wanted to know what Lewis saw when he looked at Africa, so I changed the subject. What about an issue like global warming? 'I believe in global warming', affirmed Lewis. 'I understand there are uncertainties connected with normal variation in climate, but I also observe that this is the warmest winter Boston has had in my entire life.' He recalled receiving materials in the mail from various fake grassroots groups, saying that measures to curb global warming would be very expensive and disrupt our lifestyle. 'People don't understand that there will be far greater disruptions to our lifestyle, if we wait another 50 years.'

So why, I asked, is it so hard to alert the body politic to global trouble? The answer, said Lewis, is depressingly simple: 'People don't want to know. We are resistant to hearing things that could be devastating.' He recounted a story about meeting a Catholic bishop in South Africa during the Apartheid era, and asking how it was that the white people in his

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church could live alongside the horrible inequity and suffering. 'They suffer from existential blindness', said the bishop. 'They blind themselves in order to go on living.'

I offered the opinion that the press had a duty to alert the public to issues such as those raised by *Limits*, and Lewis agreed. 'But these days', he lamented of the press in 1999, 'editors are leery of printing such alarms. It's been a bit like crying wolf.' Lewis himself would no longer write about such topics, since there were already 'hordes of environmental journalists' that specialized in them. He was focusing, he said, on the law. For most of the past year, Anthony Lewis – once the great explainer of *The Limits to Growth* – had been using his considerable experience and power as a writer to explain the impeachment of President Clinton.



In my research for this book, I had planned to talk to many press veterans from the era of *The Limits to Growth*, but my interview with Anthony Lewis told me as much as I wanted to know. Ironically, *Limits* failed to convey the necessity that was at the foundation of its message: the critical need to understand global dynamics in terms of complex, interconnected systems. Lewis, for example, could acknowledge the problems of global warming or rising population in the poorer parts of the globe, but he could not recall the connection between those phenomena and the original argument of *The Limits to Growth*. Despite his sterling efforts to explain, in his own earlier columns, many of the underlying systems concepts, he remembered the book only in terms of the negative propaganda campaign launched against it. That campaign succeeded in distracting readers by focusing on a straw-man argument: the computer model's apparent failure to predict when, exactly, the World would run out of oil and metals.

Indeed, *The Limits to Growth* is loaded with 'errors', if you measure the results of World3 by how accurately it foretold real events. By the year 2000, for example, population was projected to have reached 7 billion, about half a billion higher than United Nations estimates of the time;<sup>4</sup> instead, the turn of the millennium saw humanity somewhere below both of those projections, at just over the 6 billion mark. The *Limits* authors underestimated the effect of soil erosion on cropland, but they also underestimated the power of fertilizers and pesticides to increase crop yields (errors that balanced each other out). They also underestimated some of the efficiency gains in industry (industrial output per unit of resource).

But the 'errors' for which many critics condemned *Limits* largely re-

sulted from the critics' own erroneous reading of the text. *Limits*, they claimed, failed because it predicted that oil, copper and several other critical resources would soon run out; instead, most of these materials became cheaper and more widely available, thanks to advances in recovery technology and substitution by other sources. Copper, for example, was long thought to be a critical limiting factor for industrial development because of its growing use in telephone cabling. By the end of the 20th century, most of those cables were being converted to fibre optic, meaning they were made of sand.

The authors of *Limits* were merely assessing trends based on data they got from the US Bureau of Mines. They used that agency's numbers as the basis for analysing the lifespans of various metals and materials because they wanted to demonstrate what would happen *if* usage rates continued to climb exponentially. They also calculated estimates based on five times the known reserves for each substance, as a way of demonstrating what makes exponential growth tick: having five times the material does not mean it will last five times as long. They understood that new reserves could be identified and other materials substituted for those that became scarce. The authors of *Limits* were trying to alert people to something else entirely: the *dynamics* of the World system, its structural tendency to overshoot and collapse.

Dismissing *Limits* for 'erroneous predictions' – as so many have done, and still do, despite (among many other things) a 2008 front-page news article in the *Wall Street Journal* that declared *Limits* essentially correct<sup>5</sup> – is like faulting the seer Cassandra for her poor choice of metaphor on the eve of the Trojan War: it dangerously misses the point. The point is that the Earth has limits and that human beings are exceeding them, far faster than they realize – and perhaps faster than they *can* realize. The authors of *Limits* were concerned not about the lifespan of various metals and fuels, but about the overall pattern revealed by their modelling exercise: a large population, growing exponentially and becoming aware of the destructive impact of its growth too late to prevent disaster.<sup>6</sup>

The joint authors of *The Limits to Growth* were not the first to raise such concerns, and they have certainly not been the last. Important books, sometimes even bestselling books, about humanity's uncertain future have appeared regularly over many years. Precursors to *Limits* included Harrison Brown's *The Challenge of Man's Future* (1956), Rachel Carson's *Silent Spring* (1962) and Paul Ehrlich's *The Population Bomb* (1968). The most notable documents to be published after 1972 and up to the turn of the millennium included the sober *State of the World* reports issued by the Worldwatch Institute (still produced annually, since 1984); the internationally influential *Our Common Future*, published by the UN's

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World Commission on Environment and Development (1987); a literate and scientific lament entitled *The End of Nature*, published in 1989 by former *New Yorker* writer Bill McKibben (now the activist leader of the global '350.org' climate change movement); the passionate and intelligent *Earth in the Balance*, written by then-US senator, now-household name, Al Gore (1992); and the compelling *Earth Odyssey* by journalist Mark Hertsgaard (1999), which reported on eight years of travel all over the globe to observe the demise of Nature and the degradation of the World. Since that time, the number of similar titles published and copies sold has itself seemed to grow exponentially, like a swelling, shrieking chorus of prophetic voices, all documenting evidence that the World is growing dangerously and spinning out of control.

Along with the books came the meetings, the conferences and the huge global conclaves, punctuated in 1992 by the so-called 'Earth Summit' in Rio de Janeiro, then the largest gathering of national leaders in history – a title surpassed in 2009 by the Copenhagen Climate Summit. Vivid declarations of alarm and warning have come from scientists, doctors, artists, religious leaders and children. Global Agendas, Earth Charters and numerous international treaties have been written, signed and celebrated as great steps forward. The Nobel Peace Prize sometimes has been relabelled as an environment prize and given to scientists whose reports have alerted the world to global warming (the Intergovernmental Panel on Climate Change), a politician dedicated to promoting action on climate change (Al Gore) and an African woman who has spent her life inspiring people to take action to heal the Earth (Wangari Maathai). These and many others have all done their best to inform the World of the growing danger and to create strategies for averting catastrophe. All have made some kind of beneficial impact. But in terms of seriously addressing the core problem of runaway growth, which could be leading to global overshoot and collapse, so far all have failed.

And the World careens on.



*Kuala Lumpur, Malaysia*  
*January 1982*

*I am riding a battered and dubious bus back to the city of Ipoh, where I am working as a therapist for Malaysian heroin addicts. It's a holiday weekend, and every seat is taken; this bus appears to be an illegal gypsy, dragged into service to absorb the overload.*



*Outside the bus, the highway is bordered by dense jungle and geometrically ordered rubber plantations, in alternating swaths. The taxis are doing their usual daredevil passes, even around blind curves. I've heard that Malaysian drivers have the lowest accident rate in Southeast Asia, but the highest fatal accident rate: When accidents occur, they often involve a bus and a taxi in head-on collision.*

*Night falls, and the driver turns on his headlights. Five minutes later they go out. He pulls over to the side of the road, miles from anywhere, and tries to fix them, to no avail. Then he does something I've never seen a bus driver do, before or since. He asks the passengers what they want him to do.*

*'Jalan! Jalan!' they say, almost with one voice. 'Go on!' So he pulls back into traffic, going slower and steering by the oncoming headlights. Several taxis barely miss hitting us. Then it starts to rain. Hard.*

*Same thing: the wipers don't work. What to do? 'Jalan! Jalan!' say the passengers. Unbelievably, he goes on, steering by the blurred glow refracted through the solid sheet of water running down his windshield. Twice we swerve off the road; twice he recovers. We can't see how many taxis miss hitting us.*

*A strange silence has settled over the bus. The passengers appear spellbound by the danger, almost ecstatic. As the lone orang puteh (white person), I feel powerless to intervene. I have said my prayers and prepared to offer up my soul to the local Taoist gods, or Allah, or whoever's jurisdiction I happen to be in when the crash comes. I see the shine of oncoming headlights through the rain-drenched glass, and I close my eyes.*



To understand that humanity is on a collision course with the laws of Nature is to be stuck in what I call Cassandra's Dilemma. You can see the most likely outcome of current trends. You can warn people about what is happening and underscore the need for a change in course. Some people can understand you, and a few may even believe you and try to take action – but the vast majority cannot, or will not, respond. Later, if catastrophe occurs, they may even blame you, as if your prediction set in motion the process that resulted in disaster (self-fulfilling prophets are the most reviled). If, however, the World manages to avoid the potential

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catastrophe, thanks in part to the work of those who were motivated to action by your warning, many will point to that escape from danger as evidence of your incompetence as a prophet.

The role of Cassandra, issuing unpopular warnings of avoidable danger, is a no-win situation. Failure to convey the message effectively results in catastrophe. Success in being understood – which leads to action to avoid that catastrophe – means ultimately being proven ‘wrong’.

Being willing to be ‘wrong’ is, by itself, not enough. Your timing and your tone must be perfect. You must be ‘wrong’ at the right moment, because once proven ‘wrong’ – and the World will use every possible means to label you mistaken, as soon as possible – your credibility will be destroyed, so that thereafter your effect on the World will be minimal. Moreover, your means of communication are severely limited: if your warnings are too shrill, you will be ridiculed; too sober, and you will be ignored.

Even the best-case scenario – predicting disaster at precisely the right moment, in the most strategically balanced tone of voice – does not guarantee a successful outcome: a failed prediction of disaster. Warnings are notoriously ineffective. People may believe you and still do nothing.

The worst and most painful outcome for any Cassandra is to be proven right.



This book is about escaping from Cassandra's Dilemma, first by understanding what causes it, then by taking steps to ensure that the disastrous projections of the World's Cassandras will turn out to be wrong. This is not a book about the end of the World, or about ‘saving’ the World. The World is in a continuous process of transformative change. The task before us is to redirect that process toward an elegant set of solutions to the unprecedented problems facing humanity – and to do so quickly.

The pages that follow will give you a guided tour through the state of our World, explanations of how it came to be that way, and reflections on how to reckon on a personal and emotional level with the World's trajectory. The final four chapters offer a tour of ideas, case studies and conceptual tools for tackling a creative challenge that is as urgent as it is rewarding: redesigning the flawed systems that are now speeding us in the wrong direction. The book is, above all, a call not merely to action, but to the commitment of one's full energy and passion to the betterment of this World, and the preservation of what is precious and beautiful in Nature.

Though the word is rarely mentioned, this book is fundamentally about *love* – the practical kind, the kind that undergirds visions and ambitious initiatives, and hope itself.

The central message of this book is that ‘Growth’ must cease. If human beings do not stop their growth willingly, Nature will stop it forcefully. Paradoxically, however, for Growth to cease, ‘Development’ must accelerate.

Through all of human history, these two concepts, Growth and Development, have been joined together like Siamese twins. They must now be separated, or human civilization inevitably will come to a screeching halt. For the genuine Development of humanity to continue, our species’ physical Growth must slow down and stop. And for Growth to stop, our understanding of Development must be reinvented.

It is important to be clear about definitions. By ‘Growth’, I mean the increase in human population, resource use, material and energy consumption, and the emission of waste. ‘Development’, in contrast, refers to improvements in human technology and advances in the human condition, including health, education, intelligence, wisdom, freedom and the capacity to love.

‘Growth’ and ‘Development’ both have alternate, informal definitions that are in some ways more common, but also more confusing. ‘Growth’ often refers to ‘economic growth’, as measured by the Gross Domestic Product, the value of the stock market and other economic indicators. The term ‘growth’ is misleading here, because in these measures the only thing growing is the circulation of money – money that may or may not be linked to real products and services. Historically, economic growth, as measured in money, has been dependent on the production of ever-increasing amounts of actual goods. Increasingly, this is no longer true; the creation of economic value is more and more tied to the expansion of knowledge rather than the flow of physical materials. And, of course, many monetary transactions involve only money itself.

Meanwhile, the word ‘development’ is too often used to mean ‘Western-style industrial development’ – also known as ‘growth’ – which is tied to the propagation of free-market economies and ostensibly democratic governments. But this frame is far too limiting. Numerous writers, including India’s Vandana Shiva and Germany’s Wolfgang Sachs, have mounted vigorous intellectual attacks over many years against the notion that this kind of development is inevitable or desirable (and even against the very concept of ‘development’ or ‘progress’).

My own view is that human beings have evolved to be ambitious, and are ambitious to evolve. We continually seek security, comfort, novelty, adventure, expression, understanding and meaning. This search drives a

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continuous process of change in all cultures. Development is the never-ending quest for the true, the good and the beautiful in human life. It can never be stopped, because the urge to develop is part of what makes us human. But Development can, and must, be guided in directions that do not equate to runaway Growth, do not undermine Nature and do not cause the World to collapse.

In the simplest terms, then, Growth means increases in quantity, and Development means improvements in quality, and that is the critical distinction between these two words in the pages that follow.

The stories, ruminations, arguments and prescriptions in this book rest on two fundamental assumptions:

- 1 *There are limits to Growth.* The Earth is a system of interlocking systems, and many of those systems have clear thresholds and boundaries, beyond which we simply cannot transgress without unravelling the stability on which both life and civilization depend. The limits to Growth include limitations in land and soil for food production; available water; renewable resources such as trees and fish; industrial resources such as oil; social stability; and the capacity of Nature to absorb our wastes. Unless Growth ceases, our crossing of these and other limits will result in a series of worsening 'shocks to the system' and potentially a full-fledged collapse, as human beings struggle with each other and Nature to protect their lives and their livelihoods. Mountains of scientific evidence suggest that several of these limits have already been crossed. Given these conditions, Growth cannot continue much longer.
- 2 *There are no limits to Development.* The way we live can always be made better: more beautiful, more inventive, more creative, more efficient, more fulfilling. Technologies can be radically and continuously improved. Humans can learn, change, adapt and evolve, often with astonishing rapidity. We can repair most of the damage we have caused, restore some of what has been lost, reinvent the systems on which we depend for survival. We have transformed ourselves and our civilizations many times in the past, at both large scales and small; we are doing so now; and we will do so over and over again. Since there is no limit on humanity's capacity to evolve, Development can go on virtually forever.

Navigating this critical transition away from 'Growth equals Development' and towards 'Development without Growth' is the great challenge of our generation, and must become humanity's fundamental project for the remainder of the 21st century.



Obviously I survived my Malaysian bus ride. We had any number of harrowing escapes and near-misses, but the expected crash never happened. The bus arrived safely at the next town and we all got out, stunned or jubilant, and hired separate taxis for the rest of our journey.

This all-too-real experience has long since become an allegory for me, with many layers of meaning. There, between the lines of my own tale, I have sometimes read human foolishness, denial and bravado in the face of avoidable danger; or the momentum with which a bad situation can quickly, through cascading systemic effects, become much worse; or even, in my most lugubrious and overwrought moments, a metaphor for the global economy, careening out of control and steered by the market's invisible hands, driven to ever-faster speeds by a perversely erotic death-wish.

But these days, I see something else in that story: the simple, undramatic fact that we survived. I see evidence in that for the possible existence of grace. Call it chance, call it luck, call it whatever you like, but pray that we find a lot of it along the way. Our World can use all the help it can get.