Chapter 1

Why the Environmental Movement Needs the Right Process

IN OCTOBER 2004 THE ENVIRONMENTAL MOVEMENT AWOKE to the sobering truth: it had lost its way and was becoming terminally ineffective. The message was delivered in a most unexpected fashion: at the annual retreat of the Environmental Grantmakers Association. There two established environmentalists, Michael Shellenberger and Ted Nordhaus, released a long essay titled *The Death of Environmentalism*. A special series on "the alleged Death of Environmentalism" in Grist Magazine summarized the essay's main thrust this way: [4]

> "The paper—based on interviews with 25 leaders in the mainstream environmental movement…—argues that environmentalism is ill-equipped to face the massive global challenges of our day, particularly climate change. The movement has become a relic and a failure, the authors say, coasting on decades-old successes, bereft of new ideas, made fat and complacent by easy funding, narrowly defining 'environmental' problems, and relying almost exclusively on short-sighted technical solutions.
>
> "Mainstream green organizations' varied legislative and legal victories—and their cumulative membership rolls of some 10 million-plus—don't cut it for [the authors of the paper]. These achievements, they claim, take place against the backdrop of a broader failure to offer the American people an expansive, inspiring, values-based vision.
>
> "They conclude that the environmental movement should meet its re-maker, as it were, and give way to a more cohesive, coordinated, and ambitious progressive movement."

What went wrong? How could a movement that was so successful in the 1970s become, as the essay called it, "just another special interest" only a few decades later?

The Death of Environmentalism did not answer this question. Nor did it even prove that it was true. But it did point out, again and again, that the environmental movement was failing to achieve its objectives. Unfortunately it was riddled with conclusions that do not follow from the facts.

The essay also did not approach the topic in an analytical fashion, but instead charged right in with a broadside of provocative assertions. Some appear true. But most do not, and so in the end, the essay served mostly to create a firestorm of disagreement and confusion, along with some honest self-examination. The latter is such a good thing and so long overdue that I suspect the net effect of the essay was beneficial.

Carl Pope, Executive Director of the Sierra Club since 1992, weighed in with a long and scathing rebuttal. He pointed out that "Their case is not only flimsy, it is internally contradictory and misleading." I would tend to agree, though it did get a lot of people thinking.

However the real jewel in Pope's response for me was this: "If the paper offered a clear and constructive path forward, the internal contradictions of the analysis would matter less."

Let's explore what may be a clear and constructive path forward.

Solving the Urban Decay Problem

The failure of the environmental movement is a classic example of an intuitively obvious and widely supported solution that, while it worked well at first on easier problems, failed spectacularly on the more difficult ones. This has happened before.

In the 1950s and 1960s, urban decay and the symptoms it caused was America's biggest problem. It would eventually reach the crisis stage with the Los Angeles race riot of 1965, which left 34 people dead. Other riots occurred in Newark and Detroit. The problem continued to deteriorate, and in 1968 Martin Luther King Jr. was assassinated, which sparked further riots, including some in the nation's capitol. The riots, high levels of crime, growing discrimination and race hatred, and a host of factors increased white flight from inner cities. Businesses also moved out. This made the urban decay problem even worse, causing a vicious cycle. Despite a plethora of attempted solutions, the problem failed to get better. By the late 1960s the problem looked hopeless.

Into this void stepped Jay Forrester of MIT in 1968. Twenty one years later, in a fascinating address to the international meeting of the System Dynamics Society in 1989, he described how he began helping to solve the

urban decay problem, along with the reactions he encountered: (Italics added)

"John F. Collins, who had been mayor of Boston for eight years, decided not to run for re-election. MIT gave him a one year appointment as a Visiting Professor of Urban Affairs, bringing him into the academic orbit to meet students, interact with faculty, and advise the administration on political issues. Collins had been a victim of polio in the epidemic of the mid 1950s and walked with two arm canes, so he needed an office in a building with automobile access to the elevator level. The building with my office was one of the few that qualified. The professor next door to me was away for a year on sabbatical leave, so John Collins ended up in the adjacent office.

"In discussions with Collins about his eight years coping with Boston urban problems I developed the same feeling that I had come to recognize in talking to corporate executives. The story sounded persuasive but it left an uneasy sense that something was wrong or incomplete. So, I suggested to Collins that we might combine our efforts, taking his experience in cities and my background in modeling, and look for interesting insights about cities. He immediately asked how to go about it. I told him we would need advisers who knew a great deal about cities from personal experience, *not those whose knowledge came only from study and reading*. We needed people who had struggled with cities, worked in them, and knew what really happens. And furthermore, we would not know what would come of the effort, or how long it might take.

"*The process* would be to gather a group that would meet half a day a week, probably for months, to seek insights into the structure and processes of cities that could explain stagnation and unemployment. Collins listened and said, 'They'll be here on Wednesday afternoon.' Collins' position in Boston at that time was such that he could call up almost anybody in politics or business, ask for their Wednesday afternoons for a year, and get them. He delivered the people and it was out of the following discussions that Urban Dynamics developed.

"Urban Dynamics was the first of my modeling work that produced strong, emotional reactions. As you know, it suggested that all of the major urban policies that the United States was following lay somewhere between neutral and highly detrimental, from the viewpoint either of the city as an institution, or from the viewpoint of the low-income, unemployed residents. The most damaging policy was to build low-cost housing. At that time, building low-cost housing was believed to be essential to reviving the inner cities.

"The conclusions of our work were not easily accepted. I recall one full professor of social science in our fine institution at MIT coming to me and saying, *'I don't care whether you're right or wrong, the results are unacceptable.'* So much for academic objectivity! Others, probably believing the same thing, put it more cautiously as, *'It doesn't make any difference whether you're right or wrong, urban officials and the residents of the inner city will never accept those ideas.'* It turned out that those were the two groups we could count on for support if they became sufficiently involved to understand. That is a very big 'if'—if they came close enough to understand.

"*Three to five hours were required to come to an understanding of what urban dynamics was about.* Urban officials and members of the black community in the inner city would become more and more negative and more and more emotional during those three to five hours. If they were not a captive audience, they would walk out before they understood and accepted the way in which low-cost housing was a double-edged sword for making urban conditions worse. Such housing used up space where jobs could be created, while drawing in people who needed jobs. *Constructing low-cost housing was a powerful process for creating poverty, not alleviating it.*

"My first experience with reactions to Urban Dynamics came soon after the book was published [in 1969]. We had been running a four-week urban executive's program twice a year for department-head level people from larger cities to teach various aspects of management. A group was convening shortly after Urban Dynamics came out. I was asked to take a Monday afternoon and a Wednesday morning to present the Urban Dynamics story. I have never had a lecture on any subject, any place, any time go as badly as that Monday afternoon. In the group was a man from the black community in New York who was a member of the city government. He was from Harlem, intelligent, articulate, not buying a thing I was saying, and carrying the group with him. At one point he said, 'This is just another way to trample on the rights of the poor people and it's immoral.' At another point he said, 'You're not dealing with the black versus white problem, and if you're not dealing with the black versus white problem, you're not dealing with the urban problem." And when I said decay and poverty in Harlem in New York or Roxbury in Boston was made worse by too much low-cost housing, not too little, he looked at me and said, 'I come from Harlem and there's certainly not too much housing in Harlem.' That is a sample of the afternoon.

"On Tuesday evening, a dinner was held for the group. Neither Collins nor I could go; but several of our students attended. One student called me at home in the evening to report what was fairly obvious anyway—that

the group was very hostile. On that bit of encouragement, I started Wednesday morning.

"An hour into Wednesday morning, the New Yorker's comments began to change character. He was no longer tearing down what was being said. *His questions began to elicit information.* Two hours into the morning, he said, 'We can't leave the subject here at the end of this morning. We must have another session.' I ignored the request to see what would happen next. In about twenty minutes, he repeated it. I agreed to meet them again if he could find a time and place in the program. I was not trying to put him off; however, that usually ends such an exchange. But he went to the administration and scheduled another session.

"Later he made an appointment to come to my office to ask that I talk to a group he would invite in New York—his colleagues on his home turf. He sat in my office as relaxed as could be and said, 'You know, it's not a race problem in New York at all, it's an economic problem,' after telling me four days earlier that I was not even addressing the urban problem if I was not dealing with the black versus white issue. He gave me a report out of his brief case documenting the amount of empty housing in every borough of New York and the rate at which it was being abandoned. My point had been that too much housing meant that there was too much for the economy of the area to support. *He had all the proof right in his brief case. He simply had not realized what his knowledge meant until it was all put together in a new way.*

"Two years later a journalist asked me what people thought in the aftermath of Urban Dynamics. I suggested that he talk to others, and especially with the man in New York whom I had not contacted in the intervening two years. After the interview, the journalist called me to report that he had been told that *'they don't just have a solution to the urban problem up there at MIT, they have the only solution.'* The lesson about urban behavior had stayed clear and alive for two years even back home in his native environment. The five hours of exposure to Urban Dynamics had made a lasting impression.

"But we have not solved the challenge of how to bring enough people across the barrier separating their usual, simple, static viewpoint from a more comprehensive understanding of dynamic complexity." [5]

The first point of this long passage is that intuitive, common sense solutions to complex social system problems are usually *wrong*. When faced with proof that a solution they have supported is wrong, people tend to go into denial and anger. But if someone takes the time to explain why a solution is wrong, as Jay Forrester and John Collins did, people generally come around to a new realization, and can even become strong supporters of an alternative and correct solution.

It is my fond belief that this will happen to the many people who are now so strongly behind the environmental movement, as it is practiced today.

Why the Environmental Movement Has Lost Its Way

There is an easy-to-difficult environmental problem continuum, with easy problems at one end and difficult problems at the other. An **easy problem** has a relatively low number of sources, has clear proof of cause and effect, affects a small percentage of producers and consumers, has a small displacement in time and space, and has a relatively easy and cheap solution. A **difficult problem** is just the opposite. As problems move up the scale of easy-to-difficult, the present structure of the human system causes them to be harder and harder to solve, *mostly because there is more solution adoption resistance*. Let's apply this abstraction.

The first point of the long passage was that intuitive, common sense solutions to complex social system problems are usually *wrong*. The second point follows from the first: If a problem solving process tailored to the problem type is not used, then you cannot expect to solve the problem unless it is so easy that your everyday approach is sufficient.

This has been the case for environmentalism. Most environmentalists, organization managers included, use an ad hoc, common sense, event oriented approach to solve environmental problems. This works fine on everyday problems. It also works fine on easy environmental problems, which are the ones the environmental movement encountered at first. But when it is applied to more difficult problems, like the ones the movement encountered after the easy problems were solved, it fails most of the time. When it does succeed, it is luck that has allowed success, not problem solving ability.

An example of an easy problem was the ozone layer depletion problem. While it looked like a tremendously difficult problem at the time, it was not. It fit the pattern of easy environmental problems. It was caused mostly by a single type of behavior: chlorofluorocarbons (CFCs) released into the atmosphere from air conditioners and refrigeration equipment. It had solid proof of cause and effect, after scientific studies were completed. The problem source involved a relatively small segment of society: the CFC manufacturing and use industry. And finally, it had a relatively easy and cheap solution: switch to a substitute.

These factors made ozone depletion an easy problem, despite its apparent size and complexity. Easy environmental problems do not produce much solution

adoption resistance. As a result, by the 1990s the ozone depletion problem was largely solved.

But it is the only difficult global problem that was. The rest, such as climate change, groundwater depletion, topsoil loss, deforestation, and abnormally high species extinction rates, remain unsolved. The reason is they do not fit the pattern of an easy problem, and are therefore beyond the capabilities of the conventional problem solving approach. *This is the fundamental reason why the environmental movement has lost its way. It lacks the proper problem solving process.*

A **process** is a repeatable series of steps for achieving a goal. For example, doctors have a standard procedure for diagnosing many types of illnesses, starting with the symptoms. Other examples of processes are a constitution, Robert's Rules of Order, the method of long division, and the Scientific Method. All are a much better and more predictable way of accomplishing a goal than no process or the wrong process.

Event oriented thinking sees the world as a complex succession of events. An event is a fact that happened or will happen. In this worldview knowledge consists of a gigantic collection of haphazardly organized facts and the order they occurred or will occur in. Understanding is based on knowing what event causes another event, which in turn causes another event, and so on. The drawback is there is no underlying structure which can provide an overall pattern, only a confused jumble of events.

By extreme contrast, **structural thinking** sees the world as a complex structure composed of nodes, relationships, and interacting feedback loops. Once this structure is modeled, simulated and understood the fundamental behavior of the system becomes plainly obvious, making the system's response to solution efforts predictable.

We prefer "structural thinking" to the more common term of "systems thinking," which too often only implies thinking of the system as a whole. This is not enough.

Most difficult social problems are actually complex systems problems lying silently in wait for the naïve. Unless one is a habitual structural thinker, one's first conclusions about how to solve such problems will almost certainly be wrong.

Environmentalism Is Not Yet Environmentalism

Environmentalism could find its way again, if it looked over its shoulder at another group of problem solvers who finally did find their way.

Their turning point occurred in the early 17th century. They were a small band of dedicated problem solvers who, once they had found their way, went on to bring more benefits to mankind than any other group in history. The string of benefits includes the amazing life spans we see today, the quantum leap in agricultural production efficiency, and the innumerable creature comforts that technology has brought, such as the way you can fill your living room with the perfect sound of the Vienna Philharmonic, and if you wish, an image of the story of Tolkien's Lord of the Rings so real the mind is transported into a different reality. This string of new benefits shows little sign of stopping any time soon, because this band of problem solvers has found the ultimate tool.

These are the scientists. Their tool is the Scientific Method.

If environmentalists and environmental organizations are serious about solving difficult environmental problems, they will sooner or later be forced to make the same discovery that scientists made centuries ago. Science discovered that unless it used a problem solving process tailored to the problem type, it was doomed to eternal failure, punctuated by a small number of seemingly random successes. We now know these were lucky guesses. Science did not become science until it adopted the Scientific Method, perfected by Sir Francis Bacon and René Descartes in the early 17th century after almost 2,000 years of effort.

Environmentalism will not become environmentalism until it adopts a similar and suitable method.

Identification of the global environmental sustainability problem is now more than a generation and a half old. If the problem solving process presently used is good enough to solve the problem, it would have been solved by now. If the present approach is continued, then problem solvers are essentially doing the same thing scientists did before they adopted the Scientific Method: relying on trial and error. If a problem has a small number of solutions to try, and there is plenty of time, and erroneous solutions do not make the problem worse or insolvable, then trial and error can work. This is not the case with the difficult problems the environmental movement now faces.

After a thousand years of the Second Dark Ages, Europe entered the Second Age of Reason in the 17th century, *principally because of the effects of the Scientific Method and similar rational problem solving methods derived from it*. Also known as The Enlightenment, The Second Age of Reason emphasized the use of reason over dogma and evidence over time honored assumptions that were too often false. According to

wikipedia.com, *"The movement's leaders viewed themselves as a courageous, elite body of intellectuals who were leading the world toward progress, out of a long period of irrationality, superstition, and tyranny which began during a historical period they called the Dark Ages."*

It could happen again.

The Three Dark Ages

The First Dark Age ended when Aristotle (582 to 496 BC) invented logic. People could now correctly reason out why their world behaved the way it did. The First Age of Reason began, and Western civilization began to flourish, starting in ancient Greece.

The Second Dark Age began around the time of the fall of the Roman Empire, as barbarians periodically swept over Asia and Europe, obliterating any hope of intellectual stability and progress. The church filled the void, but even there, the First Age of Reason had been snuffed out and replaced with dogma. This ended in the 17th century when the Scientific Method was perfected.

The Scientific Method

1. Observe a phenomenon that has no good explanation.
2. Formulate a hypothesis.
3. Design an experiment(s) to test the hypothesis.
4. Perform the experiment(s).
5. Accept, reject, or modify the hypothesis.

Now civilization has slipped into a Third Dark Age. It has become mired in mass self-destruction via environmentally unsustainable practices on a massive, global scale. *Environmentalists will only be able to help civilization end this Third Dark Age and begin the Third Age of Reason if they adopt a suitable problem solving process.*

For more please see the timeline on page 380.

The System Improvement Process

Let's examine a problem solving process that could serve as a suitable starting point. This is the System Improvement Process. It is a simple, generic, highly analytical process designed to apply to all complex social system problems. It has four main steps. The first step defines the overall problem. The process then decomposes the overall problem into three subproblems, and uses steps 2, 3, and 4 to solve each of them. The three subproblems are:

1. **Change resistance** – This is resistance to adopting proposed solutions.
2. **Proper coupling** – This is moving from the present state to the goal state.
3. **Model drift** – The solution model must keep the system in the goal state. If it drifts too far the problem will occur again.

The first subproblem must be overcome so that the solution to the second subproblem can be implemented. The third subproblem must be solved to prevent overall problem recurrence.

The *goal state* of the system occurs when problem symptoms are reduced to acceptable levels. If the system is in the goal state or is moving there in time, the problem is considered solved. In the sustainability problem moving to the goal state is the same as the *proper coupling* of the human system to the greater system it lives within, the biosphere, so that the health of the two systems is automatically maintained indefinitely.

Because the popular conception of the word "solution" refers to what is actually the second subproblem, in this book the term "solution" means the solution to the second subproblem, unless defined otherwise.

In problem solving jargon, the System Improvement Process provides an extremely efficient means of searching a large and unknown "solution space" for a solution that will work. The reduction of millions of possible solutions to one that will actually work is known as Solution Convergence, which must be preceded by System Understanding so that convergence happens quickly and correctly.

Here is an outline of the process:

1. **Problem Definition** – What is the problem? This is defined in terms of the goal state versus the present state of the system.
2. **System Understanding** – Why are the three subproblems occurring?
   - 2.1 Why is there such strong resistance to adopting the solution?
   - 2.2 Why is the system not naturally in the goal state?
   - 2.3 Why is the system not staying in the goal state?
3. **Solution Convergence** – How can the three subproblems be solved?
   - 3.1 How can adoption resistance to the solution be overcome?
   - 3.2 How can we move the system to the goal state?
   - 3.3 How can we keep the system in the goal state?
4. **Implementation** – Once a solution is found, the three subproblems are solved in this order:
   - 4.1 Overcome resistance to solution adoption.
   - 4.2 Move from the present state to the goal state.
   - 4.3 Stay in the goal state indefinitely.

The first step formally defines the problem to be solved. This greatly focuses all subsequent problem solving effort. The second main step seeks to understand the system's leverage points so well that the third main step, converging on the solution, is relatively trivial. The fourth main step implements the solution.

Use of a process like this changes everything. It allows problem solvers to more easily proceed in an analytical fashion, one much more likely to solve the global environmental sustainability problem in time.

The four main steps are:

Step 1. Problem Definition – First the problem to solve is formally defined, in terms of the symptoms to be alleviated. This gives a clear, unambiguous definition of exactly what system behavior must change to consider the problem solved. The result is all problem solvers are now working on the same problem, with a minimum of effort. All work is now very focused.

Step 2. System Understanding – Next the system is examined, with a single guiding question: *Why are the three subproblems occurring?*

This question decomposes one large problem into three smaller, distinctly different problems, each of which is much easier to solve. For a difficult complex system problem, this has the effect of taking a giant Gordian knot of incomprehensible complexity and deftly turning it into three much simpler and therefore potentially solvable problems. *In practice this decomposition is so powerful it can transform a problem from insolvable to solvable.*

Unless the guiding question is answered deeply and correctly for all three subproblems, any solution selected cannot be anything more than an educated guess. Nor can the solution get to the root of the problem. These of course are the prime reasons why past solutions have failed—they were no more than intuitive hunches combined with political expediency, and failed to get to the fundamental causes of the problem.

The output of this step is a comprehensive model of understanding based on structural thinking, the core of which is a computer simulation model of the system and how it behaves. Note this is precisely what Jay Forrester had to do to solve the urban decay problem.

Step 3. Solution Convergence – Only after a high level of system understanding is reached does the Solution Convergence step begin. If the previous step has been done well, then this step is almost trivial. This is because system behavior is now predictable. It is now so predictable that solution search can very quickly converge on the solution with the preferred outcome. Once that happens the problem is "solved." The key output of this step is a collection of solution elements and an Implementation Plan.

Step 4. Implementation – The Implementation Plan is carried out. It uses three sequential and slightly overlapping phases to solve the three subproblems.

In the first phase, resistance to adopting the solution is overcome. This is the phenomenon of *change resistance*, which is very common in complex social system problems. The main reasons social agents resist change are strength of habitual behavior patterns, the one time cost of change, and the perception that an agent will be made worse off by the change. For the sustainability problem the last is the biggest factor. For example, most for-profit corporations are strongly resisting becoming sustainable because they perceive it will reduce short term sales and profits.

In social systems, solution adoption resistance is usually the crux of the problem. For example, in the global environmental sustainability problem, civilization knows by now what must be done: live sustainably. But it doesn't want to take the next step and actually do it, for an intricate variety of reasons. Those reasons cause "change resistance," which is the social side of the problem. This is what the first phase of the Implementation Plan overcomes. The second and third phases are much easier, and are explained elsewhere.

There are three main reasons for the success of the System Improvement Process. The first is decomposition of one large problem into many smaller problems. This is the main reason SIP is so powerful. The decomposition has two dimensions: the four main steps and the three subproblems. Solving these 3 subproblems using the 4 main steps gives SIP a total of 13 steps.

In a formal process like SIP, each process step is a problem to solve. Processes make work more efficient by redefining one big job into lots of much smaller and hence easier to perform jobs. When applied to difficult complex system problems, this decomposition is so powerful it can routinely transform a problem from insolvable to solvable.

Which would you rather try to solve: One big impossible problem or 13 little easy ones?

The second reason is the presence of the System Understanding step. It is usually almost totally absent from popular problem solving approaches. Yet this is where problem solvers should spend about 80% of their time.

The third reason is the process addresses the change resistance side of the problem. In difficult social problems this is usually the crux of the problem.

The Importance of Modeling

The third point of the long passage above is the importance of modeling. Jay Forrester would have been totally unable to help solve the urban decay problem without the tool of simulation modeling. It was a form of Gedanken (thought experiment) that lay at the heart of his process.

All conscious decisions are based on mental models. However the mind has its limitations. If a thought experiment is too big to be adequately represented by a mental model, then its representation requires a tool that can handle a bigger model than the mind can. For complex social systems, the only known tool that can do this well is the one Jay Forrester invented: computer simulation modeling.

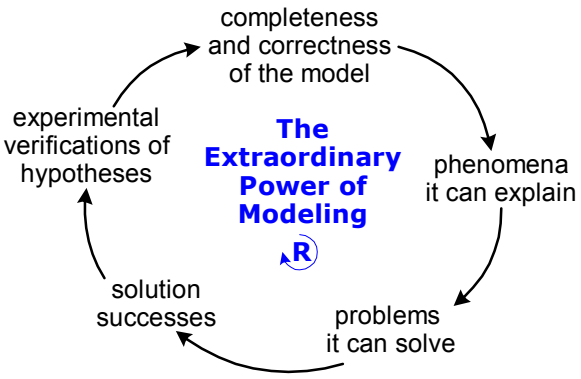
A formal model can not only handle a larger model than the mind can. It can also handle it *correctly*. This is because the human mind is notoriously unable to handle what have become known as feedback loops. A **feedback loop** exists when a change in one node of a system results in changes elsewhere that ultimately come back to affect the node still more.

The special series on "the alleged Death of Environmentalism" in Grist Magazine also had this to say: (Italics added)

> "Of all the points made by [the Death of Environmentalism essay], perhaps the most telling is in a follow-up post on the Breakthrough Institute blog: 'Nearly every profession, from public health to business to law, has research studies, conferences, and peer-review journals dedicated to *evaluating what's working and what's not. ... The environmental community has nothing like this.*' "

"Evaluating what's working and what's not" is the use of a formal process that employs a critical feedback loop. This loop improves one's mental and/or physical models of the world. Every time an experiment or solution attempt [6] is tried, the results can be evaluated to see if the hypotheses of the proposed solution was confirmed or denied. Such a loop would look about like the one shown, which illustrates **The Extraordinary Power of Modeling**.

Let's walk through this reinforcing feedback loop starting at the top, using the convention of underlining the name of each node. The loop is first created when a mental or physical model begins to be constructed. This increases the completeness and correctness of the model. This in turn increases the number of phenomena it can explain, which also increases the number of problems it can solve. This quite naturally increases the number of solution successes. If each success is examined to see what can be learned from it from the viewpoint of the Scientific Method, then this increases experimental verification of hypotheses. Each hypothesis is a rule of cause and effect. Simplifying, a rule is a model node, so this in turn increases the completeness and correctness of the model, and the loop starts all over again. It grows and grows, because it is self-reinforcing.



Those familiar with the Scientific Method may have noticed that the loop is also an expression of that. The "model" in the loop is the body of scientific knowledge built up over a period of time. Knowledge is the same as a model of understanding of the world. Thus the loop could also be named **The Extraordinary Power of the Scientific Method**.

The environmental movement has no such loop, as the above quote from Grist Magazine pointed out. The loop is not at all difficult to build, as so many other fields have shown. *Until such a loop is built, environmentalism is not yet environmentalism, nor is it science.*

The Folly of Pushing on Low Leverage Points

The better the model, the better the understanding of a complex social system. Such systems are so chock full of feedback loops that unless they are modeled, their behavior will remain a mystery. The unaided mind will be unable to understand any but the simplest cases.

This is because hidden feedback loops cause social systems to behave counterintuitively. You expect them to behave one way, but upon trying a solution based on that assumption, they behave in a different, often highly unexpected way. This leads to the trap of pushing on low leverage points to solve a problem, such as happened in the urban decay problem. This is the trap the environmental movement has fallen into, which is explained in chapter two.

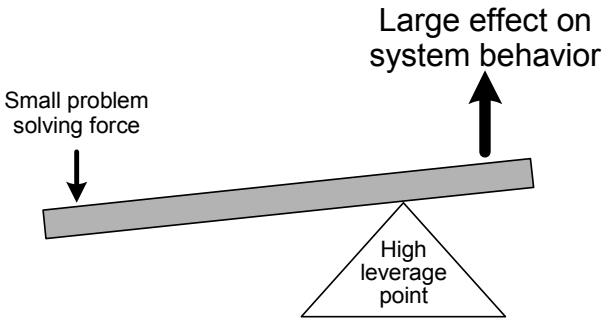
Why do people use low leverage points again and again? The founder of the field of system dynamics, Jay Forrester, has this to say: (Italics added)

"Social systems are inherently insensitive to most policy changes that people select in an effort to alter behavior. In fact, a *social system draws attention to the very points at which an attempt to intervene will fail.* Human experience, which has been developed from contact with simple systems, leads us to look close to the symptoms of trouble for a cause. But when we look, we are misled because the social system presents us with an apparent cause that is plausible according to the lessons we have learned from simple systems, although *this apparent cause is usually a coincident occurrence* that, like the trouble symptom itself, is being produced by the feedback loop dynamics of a larger system." [7]

To solve a problem, the System Improvement Process first defines the problem. Then it analyzes in great detail exactly why the problem is occurring. If this is done well, two things become obvious: One is where the *low leverage points* are that problem solvers have been pushing on. Because they are low leverage, pushing there fails to solve the problem. The second is where the *high leverage points* are.

This is an extremely powerful way to analyze social system problems, because the results cast bright spotlights on those places in the structure of the human system that are making the critical difference. At last problem solvers can see why they have been failing. *They've been pushing on low leverage points and didn't realize it.* That's now as clear as day. And because they can also see what they have to do differently to solve the problem, a whole new alternative to the folly of pushing on low leverage points almost magically appears: push on the high leverage points instead! That too is clear, so clear that what to do is now blindingly obvious.

What exactly is leverage? What do we mean when we say we must push on high leverage points to have the highest probability of solving complex social system problems, given the low amount of force that most social problem solvers tend to have, such as environmentalists?



The choice of the right high leverage point allows a small problem solving force to have a large effect on system behavior. This requires choosing the right change force and the right application point. In a complex social system, leverage is the use of *indirect* force rather than *direct* force. The highest leverage is achieved by pushing on high leverage points such that feedback loop dominance changes radically. This requires seeing the social structure involved, so that the right high leverage points are used and they are pushed on correctly.

Leverage is the ratio of change in input to change in output. A **low leverage point** is a place in a system where a small amount of force causes a small change to system behavior. A **high leverage point** is a place in a system where a small amount of change force (the total effort required to prepare and make a change) causes a large amount of predictable, favorable response. [8]

An example of a low leverage point would be pushing on the side of a ship to change its course. This would require a large amount of force to have the intended effect. But if the high leverage point of pushing on the rudder is used instead, it takes only a small amount of force to achieve the same effect.

At a favorable high leverage point a small structural change to a system can cause the system to behave much more favorably. *Only the use of the correct high leverage points can solve a difficult complex social system problem.*

For example, consider the very simple *event chain* of A causes B and B causes C, where C is the problem symptom. Pushing at B is direct force, but pushing at A is indirect. In this case, if there are no further causes of A, B, or C, then A is the root cause. This is the most common way people see their world—as one that consists of events, event chains, and root causes. This is *event oriented thinking*.

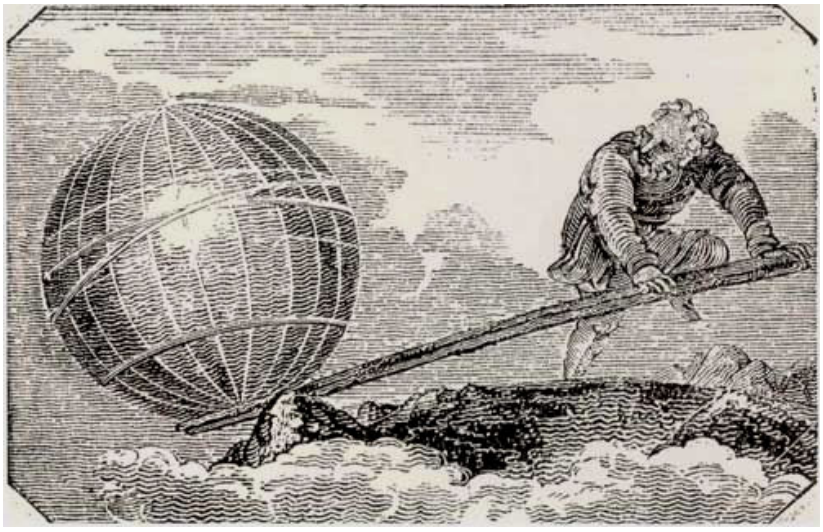
Let's examine a second case using a *structural thinking* viewpoint: Suppose A causes B, B causes C, C causes D, and D causes A. This is a feedback loop. Because we have gone deeper and are now correctly seeing dynamic systems as composed of many feedback loops, we can no longer go to the end of an event chain and blithely declare that to be the root cause. Instead, the so called root cause is the structure of the system. **Structure** is the shape of a system's key feedback loops.

Event oriented thinking is seeing the world as consisting of events, event chains, and root causes. Better is **structural thinking**, which sees the world as what it really is: a complex interacting structure of nodes, relationships, and feedback loops. *The key tenet of struc-*

tural thinking is the behavior of a system is an emergent property of its structure.

Simple problems are simple enough to be solved by event oriented thinking. They are easy to solve because they yield to **root cause analysis**, which means following one or more event chains all the way to their end, where the root cause lies. On the other hand, difficult social system problems are the result of hidden, illusive, totally counterintuitive feedback loops. This makes them impossible to solve using traditional root cause analysis, because feedback loops have no end.

Therefore, in order to solve the difficult problems we now face, environmentalists must abandon thinking in terms of events and simplistic root causes, and switch to thinking in a wholly new way: *the behavior of a system is an emergent property of its structure.*



It was Archimedes (287 to 212 BC) who said "Give me a lever long enough, and a place to stand, and I can move the earth." He should know, because it was Archimedes who discovered the law of levers.

Summary and Conclusions

The environmental movement has indeed lost its way, as results have shown. And, as *The Death of Environmentalism* pointed out, it has no credible plan for finding its way.

This has happened before. The failure of the environmental movement has a historic parallel: the US urban decay problem. There problem solvers also tried intuitively obvious solutions for so long that the system threatened to soon turn into mass self-destruction.

The urban decay problem was solved by the application of simulation modeling. As that model showed, the four leading solutions turned out to range from outcome neutral to highly detrimental. None were actually helping to solve the problem. But as the model also showed, there was a surprisingly simple workable solution that had not been seriously tried. The lesson here is environmentalists must model to avoid the same trap.

The environmental movement has lost its way because it is now where science was before scientists adopted the Scientific Method as their central problem solving process. *Environmentalism will not become a true science until it adopts a similar and suitable method.* Only after it has found the right process can the environmental movement lead humanity out of the Third Dark Age and into the Third Age of Reason.

This can be done only by the rigorous use of a formal problem solving process that fits the problem type. An example of such a process is the System Improvement Process. Most importantly, it addresses the *social side* of the problem.

This process employs the powerful tools of structural thinking and simulation modeling. Skillful application of these tools will lead problem solvers away from the low leverage points they are currently pushing on to high leverage points. *Only the use of the correct high leverage points can solve a difficult complex social system problem.*

This is not to say that every environmentalist needs to become a process and modeling expert. But it does mean that every environmental organization should be driven by a suitable process and have sufficient structural thinking and modeling skills at its disposal, unless it is one of the few that is working on problems so easy they do not require these tools.

Process driven problem solving and model centric reasoning are highly analytical techniques. They require high amounts of training and skill to do well. Probably more than 90% of the population has never been exposed to either of these skills. Thus the environmental movement has a sea change ahead. It is the same change that took science centuries to go through, and takes the average profession many decades. This has grave implications.

Such a transformation is so pervasive and deep, and runs so against conventional wisdom, that it qualifies as a paradigm change. Furthermore, the clock is ticking. The projections in the third edition of *Limits to Growth* in 2004 show that *Homo sapiens* has, at most, only a few decades left in which to change course.

Can environmentalists and environmental organizations go through this critical transformation in time?