The Dialectics of Climate Change

By Marc Brodine

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INTRODUCTION

Humanity faces a general eco-social crisis expressed in dysfunctional relationships with the rest of nature. This general crisis results from imbalances between human activity and energy, soil, water resources, non-renewable resources, microorganisms, livable habitat, and atmosphere. Our agricultural and industrial systems exploit and deplete nature, causing and exacerbating this crisis. This challenges our capacity to confront, understand, and solve these problems.

All of these problems have been growing during the centuries of capitalist development. They are now accelerating toward fundamental tipping points past which recovery will be increasingly painful and costly to humanity and to our social and economic systems.

We also face linked social and economic crises: racism, the oppression of women, massive debt both public and private, falling incomes for hundreds of millions of workers, large-scale unused productive capacity providing a drag on economic development, mass unemployment, escalating income inequality, lack of health care, billions of people with little or no access to safe water, to mention just a few.

Our ability to understand the challenges facing humanity, from global climate change and from linked social and economic problems, will be strengthened by applying the laws of Marxist dialectics. Dialectics can help us to a deeper understanding of nature and our relationship to it, integrating the knowledge gained by science with working class experience, organization, and philosophy.

A HOPE

Detailed discussions of the validity of global climate change can be found elsewhere. My hope is that I can present the laws and understandings of dialectics using accessible language rather than the sometimes awkward translations from German phraseology or stilted Soviet textbooks. The last section offers some ideas on where to start to fix the ecological situation the world is in.

Engels, in his graveside address for Marx, noted that "Marx discovered the law of development of human history: the simple fact, hitherto concealed by an overgrowth of ideology, that mankind must first of all eat, drink, have shelter and clothing, before it can pursue politics, science, art, religion, etc. . . ."

The fundamental reality of all human life is that our lives are based on food, water, and resources that come from nature. As well, the ways in which we create and distribute food, drink, and shelter impact the natural world we depend on.

Many questions that climate change raises relate directly to aspects of Marxist philosophy: the interconnectedness of all things; the world as a complex of interlocked processes; "tipping point" qualitative transformations that arise from seemingly small quantitative changes; the unity and struggle of opposites including within

photo by Janine Brodine

Illustration by Sam Heimer

the natural basis of life; the back-and-forth exchanges between the processes of nature and the activity of humans. Dialectical thinking is the cure for mechanical, linear models which limit our appreciation of the complexity of change and of multiple complex adaptive system interactions.

We need to think dialectically (keep multidimensional change ever-present in our minds and focus on the interconnectedness of all phenomena) or else our "solutions" will end up creating new and potentially worse problems. Or we might give up in the face of the challenges and let nature take its course no matter what happens to human life.

Environmental examples illustrate dialectical principles, and dialectical thinking illuminates the interconnectedness of human systems with the processes of the natural world. This essay is not intended to be comprehensive about either, but to be a start at integrating the concepts.

DIALECTICS, VERY, VERY BRIEFLY DEFINED

Marxist philosophy is called Dialectical Materialism. It combines the dialectical study of change with a materialist outlook on life, and presents a unified view of human activity and the nature of which humans are an active part.

Dialectics is the study of change, of how and why change happens, and of the observable features and patterns of change. Everything is actually a process, so dialectics views the world as a complex of processes which constantly change and constantly affect each other. Any phenomenon we observe represents only a temporary equilibrium of opposing material forces, a momentary "snapshot" in a process that came from change and leads to more change.

Everything changes, and in the process goes through phases during which slow small changes accumulate. These changes have

both internal and external causes. At some point (exactly which point is different for each process), as a result of those accumulated quantitative changes the existing equilibrium breaks, leading to qualitative change, to a revolutionary leap to a new state of existence.

When water is heated, there is a slow accumulation of small quantitative changes, until the critical threshold of 212 degrees is reached, the water boils, and water transforms into steam. The difference in the water between, say, 180 degrees Fahrenheit and 181 degrees is minimal, but the accumulation of heat, one degree at a time, ultimately leads to water's tipping point.

> All value to humanity comes either directly from nature or from nature altered by human labor. If we compromise nature's ability to regenerate the materials we need for our survival, we compromise our own ability to survive.

All processes have points at which they change to a qualitatively new state; we just don't always know where they are with the precision and predictability of water becoming steam, or transforming into ice at colder temperatures. All processes are also subject to the pressures of other systems—for example, the boiling point of water changes depending on what elevation you are boiling it at, due to variations in atmospheric pressure.

Human systems don't stay the same any more than the systems of nature. Human systems also have contradictions; among them are contending classes which drive change. Marxism is the activist philosophy of the working class. It provides workers and their organizations with a scientific method to evaluate constantly changing reality, provides a guide to action, and sees the activity based on that evaluation as the ultimate determinant of truth.

Dialectical materialism helps us understand the paradox of why, in a class-divided society, scientific and industrial development leads to increased poverty rather than to shared improvements in the living standards of all people, why exponential increases in the world's productive capacity and food have led to more poverty, hunger, and homelessness. It provides us with the means to understand, and ultimately reverse, the deepening hunger, poverty, and social crises caused by capitalism. It helps illuminate the causes, interactions, and potential solutions of the growing environmental crises humanity faces.

Human consciousness is the combined social and individual reflection of reality, and builds on accomplishments and understandings that grew from previous human activity and thought. The reflection of reality in human consciousness inevitably lags changes in reality; this lag alone can cause errors in human thought and action. Time, effort, and activity are essential parts of the process of understanding and knowing. Understanding takes time and effort and grows not only from study and abstract reasoning but from the process of doing.

LIMITED CHOICES

When a society comes into unresolvable conflict with its environment, there are three basic adaptations which can happen:
1. the society can move elsewhere and continue as before in a new place (the main adaptation in ancient times);
2. people can stay where they are and transform their society and economy; or
3. the society and people can die out.

Two factors have now eliminated one of these options: our globalized economy and globalized environmental crises have left us with nowhere else to go.

Our three options now are: we can change our economic practices, humanity can survive but in a diminished fashion in a much more inhospitable world, or perhaps we can perish. *Nature doesn't "care" about humanity; humanity must care about nature. We must work to enable nature to sustain us*.

EXPLOITATION IS BAD, INCLUDING ENVIRONMENTAL EXPLOITATION

Virginia Brodine, in ***Red Roots, Green Shoots***, offers the following definition of environmental exploitation:

> The exploitation of the environment is the expropriation of land, natural materials, and energy sources at one end of the production process and of the waste-absorbing capacity of the environment at the other end, without paying the cost of maintaining the capability of the environment to continue supplying the one or to continue absorbing the other.

All value to humanity comes either directly from nature or from nature altered by human labor. If we compromise nature's ability to regenerate the materials we need for our survival, we compromise our own ability to survive. We can't just take and take from nature without adjusting ourselves to nature's need to replenish itself and to absorb, integrate, and detoxify waste products. We depend on nature for our survival—if the air becomes too polluted for human health, we can't simply breathe something else. We can't endlessly alter the balance of natural systems such as the atmosphere without suffering the consequences of that alteration.

There are direct human costs of capitalism, rooted in the exploitation of human labor for profit, but there are also serious environmental costs, as capitalist production and agriculture exploit the non-renewable resources we depend upon in an ever-speedier race to catastrophe.

Human life is threatened when the natural conditions which permit life become altered in basic ways. Humans are dependent on atmosphere, on water, on photosynthesis in plants which feed humans and animals. Together, the plants and animals provide us with essential sustenance. Take any of these away for long enough (and it doesn't take very long, especially with oxygen and water) and human life ceases to exist. Negatively impact any one of these and, sooner or later, that will have negative impacts on all the others, and negative consequences for humanity.

Illustration by Jennie Santos

WAIT AND SEE?

When scientists share their worst fears about where our planet is headed, they come up with a great variety of doomsday scenarios. Skeptics point out the sometimes overblown nature of these scenarios. But that shouldn't give us any confidence in a wait-and-see approach.

When we are faced with one potential world-shaking crisis, the probability of that one crisis may be small enough to risk. But when we are threatened with a series of different but related potential crises, the chances that one or another of them will happen are much greater. We can't now predict exactly which of the interlocked problems will first lead to major negative tipping points. But because we are faced with so many related problems, we can be pretty sure that if we don't act, one or another of these crises is going to get us.

That's the nature of risk probability: many risks multiplied by many opportunities for system breakdown multiplied by inaction (or inadequate action) equals inevitable crisis. Because the world is a complex of interlocking processes with dynamic interrelationships, once any one of these crises hits, the chances of the others occurring escalate rapidly.

For example, if global warming heats the areas of the earth covered by permafrost, the permafrost will melt, releasing millions of tons of methane and CO2 which have been frozen for hundreds of thousands or millions of years, putting more tons of greenhouse gases into the air—global warming connected to permafrost melting connected to more carbon dioxide released, causing more global warming, making the crisis worse. Similarly, more global warming leads to dryer soil and drought in many areas, leading to more forest fires, which by burning massive amounts of wood release more CO2 into the atmosphere, causing more global warming.

More forest fires result in more glacial melting. More glacial melting results in more forest fires. Each crisis exacerbates the others, escalates the others. More forest fires heat the atmosphere, melting more permafrost, releasing more greenhouse gases, melting more glaciers, causing the earth to absorb more of the sun's heat, causing more global warming. All these are interlocking path dependent processes, each affecting all the others, acting as force multipliers.

The risks and costs of waiting until we gain perfect certainty are unacceptable. We can already see glacial melting taking place in Greenland and in the Arctic and Antarctic at much faster rates than anyone predicted even a few years ago. Huge glaciers in Glacier National Park and at the top of Mt. Kilimanjaro are already well on their way to disappearing (as are almost all glacial systems, with a few exceptions). We can measure the increased amounts of carbon dioxide and methane in the atmosphere, and we know how much of this is coming from human activity. We know some of the potential for seriously negative impacts on human society. If we wait, we risk it all.

Some argue that because we don't know everything, that must mean we don't know anything, or at least not enough to begin taking action. But taking action is part of what will lead to more knowledge. Not taking action leaves our knowledge in an unformed, abstract state. Taking steps gains us more knowledge that we need for our practical purposes.

> There are direct human costs of capitalism, rooted in the exploitation of human labor for profit, but there are also serious indirect costs, as capitalist production and agriculture exploit the non-renewable resources we depend upon in an ever-speedier race to catastrophe.

Some doomsday scenario predictions have failed to materialize, which tells us that real life is both more complicated and more fundamental than our theories. Some use this to claim that therefore all predictions of looming danger are false, but inaction would leave us more helpless in the face of natural forces unleashed against the needs of humanity, would leave us with less knowledge, less experience, worse problems, and less capacity to cause positive change.

In the ten thousand years of agriculture and the four or five centuries of capitalism, humans have transformed our relations with the microbial world, the seas, the vegetation, the crust of the earth,

and now the atmosphere. It is clear that the crisis of our species is inextricably entwined with capitalism and its inefficient and unjust use of resources for the profit of a relative handful of individuals. *We have now reached a new successional stage in our relations with the rest of nature.*

If we create ways to transform our relationship to nature by changing our social and economic systems, we may be able to adapt and create a new ecology that will enable our species to continue. Otherwise, we will be acted upon; we will be subject to the often brutal workings of climate change and natural selection.

Dr Hans Oerter/AFP/Getty Images

◀ **This tabular iceberg recently broke away from Antarctica. Scientists see this break away as an important clue to the rate of global warming.**

THE BASIC CHALLENGE

The real question is: *will we continue to force natural systems to work together against humanity? Or will we restructure our social, economic, agricultural, and industrial systems to work more in harmony with them?*

The longer we wait to make a serious start on a mass scale, the more expensive the changes will be, the more severe the adjustments we will have to make, and the more social and economic dislocations will be involved.

The interconnection of all processes must inform our actions. A single-minded focus on global warming and greenhouse gases can lead us to ignore other crucial environmental challenges—the increase of persistent organic pollutants (POPs) everywhere in the world, the criminal use of antibiotics to maximize profit in the meat industry which helps lead to super-resistant diseases, the use of inadequately tested genetically modified non-reproducing seeds, the dumping of toxic chemicals, the poisoning of water systems, the imbalances from monoculture, and many more.

These are all threats to humanity's sustainable balance with the rest of the natural world. Even short of a threat to humanity as a whole, these problems already contribute to the premature death of many, to more drought, disease, famine, and to more intense storms hitting denser human populations.

Climate change leads to lower rainfall in many agricultural lands causing food supplies to plummet, and ultimately contributes to increased famine. The same climate change is already leading to rising sea levels which threaten to increase the flooding of densely

populated areas such as Bangladesh, Indonesia, the Philippines, Holland, and much of Florida and coastal California. This can lead to increasing the already severe refugee problems the world is experiencing. These interconnections can exacerbate each problem, intensifying the negative impacts on human populations and on agricultural systems.

Our changing environment affects the vulnerability of organisms to disease, and creates new habitats for germs. The organism of Legionnaire's Disease is found all over the world but has always been rare in its human affects until recently because its food requirements are so complex and unusual. But that organism can tolerate heat and chlorine by getting inside of a protozoan. Industrial heating columns and water systems kill off the competitors of this organism and also create a biofilm that enables the organism to thrive in hotels, rest stops, and other gathering places. As well, the fine spray of modern shower heads can carry it to the deepest corners of our lungs. So human change can intensify natural threats to humans in ways we can't always predict.

"New" diseases come from somewhere, and we can't prevent them in advance of knowing about them. When such diseases hit our growing urban populations, many of which have inadequate at best water and sewage systems, the stage is set for communicable epidemics. As well, diseases such as malaria, which used to be mostly restricted to the tropics, are spreading farther north and threatening new populations, because of the limited global warming we're already experiencing.

Acid rain injures trees. Bark beetles can then penetrate the cracks in the bark, carrying fungus spores with them that kill the trees. Killing some trees can weaken an entire forest ecosystem. The problem is not only acid rain, it is the chain of consequences that follow in its wake. As well, acid rain has more than one cause and more than one effect.

"Green revolution" varieties of seeds increased yields per acre, but they also created dependence on a whole package of pesticides, fertilizers, irrigation, and mechanization (which only some farmers could afford). This led to soil depletion, erosion, draining water tables, and undermining the long-term productive capacity of the land. A supposed solution turned into a problem. A short-term victory has caused a long-term crisis.

Small changes in wind patterns in the Indian Ocean can affect whether the monsoons that Asia relies on for rainfall to grow crops will happen or not, and that affects the pressure on other water systems. "Green revolution" crops which rely on massive amounts of water can have the unintended result of farmers draining the water table below the surface. If this is done at such a rapid clip that water is pumped out much faster than rain replenishes the underground aquifers, a particular source of water becomes a non-renewable resource (this is happening to the Ogallala Aquifer in the U.S. West). Solving the food problem by creating a water problem is short-sighted, and will ultimately cause another food problem. All natural systems have evolved to work together, and there is no magic by which humans can separate one process out of the natural system.

> Human life is threatened when the natural conditions which permit life are altered in basic ways. Humans are dependent on atmosphere, on water, on photosynthesis in plants which feed humans and animals. Together, the plants and animals provide us with essential sustenance. Take any of these away for long enough (and it doesn't take very long, especially with oxygen and water) and human life ceases to exist.

Another example is the Dust Bowl during the 1930s. It illustrates how a problem, once started, causes other problems: accelerated erosion leading to dust conditions leading to changes in weather patterns leading to the collapse of agriculture in the region, leading to large-scale human migration (and leading to extra exploitation of and discrimination against "Okies"). These conditions were reversed in some areas, but not in most and only with great difficulty and over a long period of time, and there have recently been returns to dust conditions in some places.

The history of human life has been a series of successive entire ecosystems appearing and then being replaced either due to external events or due to their own impact on the environment. A

cycle is observable in nature following human abandonment: after a cultivated field is abandoned, there is usually a rapid colonization by grasses, vines, and annuals. Under their shade, bush and tree seedlings sprout and may squeeze out the early colonizers, only to be replaced in turn by slower-growing shade-tolerant trees. Each negation is in turn negated, but none of this happens instantaneously, and none of it happens on the time scale that humanity requires.

We tend to take soil for granted. Like water, soil too can be turned into a non-renewable resource when soil depletion and erosion are accelerated by human activity to the point that they overwhelm soil formation. Chemical fertilizers can boost output, but only temporarily—the soil begins to act like a heroin addict, requiring ever larger doses of fertilizer to get the same effect, depleting the soil faster in the process, and increasing run-off which chemically contaminates streams, lakes, and rivers. As Marx noted, "All progress in capitalistic agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress towards ruining the more long-lasting sources of that fertility."

Stan Honda/AFP/Getty Images

▲ **Demonstrators calling themselves "Billionaires for Coal," of the Rainforest Action Network walk to the JP Morgan Chase office in the Wall Street district of New York. The group was protesting the financing of new coal-fired power plants in the US by seven large banking companies, part of "Step It Up," a national day of action addressing global warming.**

Soil and water can replenish and regenerate, but it can take decades or hundreds of years, and then only if human-caused erosion and deforestation haven't stripped the land back to bare rock, or if humans massively drain an aquifer, in which case it can take thousands of years. And when human societies are under the pressure of food crises, they tend to exploit resources even more in a desperate but vain drive to catch up to the problem, becoming a self-reinforcing cycle of environmental degradation and destruction. The interactions between human-driven climate change, water overuse, and overuse of soil can overwhelm the ability of natural systems to support human and animal life, first in areas that have long been teetering on the edge of agricultural collapse, then in a more generalized fashion throughout the world.

How can we gain an integrated understanding of all these related crises?

THE LIMITS AND POTENTIAL OF DIALECTICS

Dialectics is a way of thinking about dynamic change in the real world; dialectical principles and laws are not mathematical formulae. Dialectics can't function as an equation that gives us a simple solution based on a straightforward computation. Dialectics can't tell us exactly where each tipping point is, because it is different for each process and changes over time and in relation to other pressures. Dialectics won't somehow automatically illuminate all the things we don't yet know about nature or how all the processes of nature interact.

Dialectics is not a series of "truths" to memorize, but rather a way of thinking that helps us get to the root causes, to the fundamental nature, of whatever we are trying to understand better. Dialectics is a method to use to reach understanding, *not the understanding itself*.

Dialectics is a series of propositions about how to think about the world and its interacting parts. It suggests what kinds of questions to ask, what patterns to look for in any process. There is a structure, an architecture, of all change, which plays out in unique ways in each process. We always have to look at the interconnections of a process with the rest of the world, look for the essential quantitative and qualitative changes taking place, look for the history and trends of the process, and look for the intersections between human and natural processes. We must always look to the connections of any issue with both small-

er and larger systems, and pose questions so they are big enough to get an answer that fully addresses the issue. Dialectics tells us that the truth is always the whole, not merely the parts considered in a linear or mechanical fashion.

Things are the way they are, but they haven't always been that way; and they won't always be that way. We need to not only see what things look like now, but also learn what they used to be like, what their trajectory is, what their connections to other changing processes consist of, and what external and internal contradictions and forces drive each process.

Static, mechanical approaches and constructs don't fit the natural world; they can't flow with the interacting evolution of multiple networks of linked living things. Analysis based on appearance and form, rather than essence and content, is always superficial. We need to understand processes more deeply if we want to make informed decisions that result in real progress, based on understanding matter in motion.

Processes are connected across any boundaries we see or construct. Human biology is a socialized biology—the significance of something depends on its social and natural context. Organisms select, transform, and define their own environments even as they are limited by those environments. Ideas become an active part of nature, interacting to change the social conditions that helped bring the ideas into existence in the first place.

WHAT'S WRONG WITH EITHER-OR THINKING

Much of the history of logic, science, and philosophical systems has been plagued with linear, either-or, reductionist thinking. Either something exists or it doesn't. Either one thing is true or its opposite is true; they can't both be true. This kind of logic can be useful when considering abstract ideas and propositions. However, it doesn't correspond to the way the real world works.

In the real world, contradictory things can both be true. They are often, oddly, mutually reinforcing. Change is contradictory, multidimensional, and multidirectional. What may logically seem like mutually exclusive opposites can both be true at one and the same time, can be mutually necessary for each other.

For example, global warming is causing the edges of the ice fields in Antarctica to shrink. At the same time, warmer water and warmer atmosphere lead to more moisture in the air, which leads to more snowfall in colder areas, which leads to a thickening in the middle of the ice fields. Shrinking ice fields and growing ice fields are both true (though the dominant trend is the shrinking). Warmer weather on average and more snowfall in some places are both true. Global warming melting ice fields leads to colder water in the oceans, which flow to temperate zones, temporarily chilling them, delaying the full warming process. More rainfall *and* more droughts are happening.

This is why we need to learn to think dialectically, to understand the contradictory nature of and relationships, to understand the constant change that flows from contradictory struggles, to understand that small constant changes cause processes to reach tipping points where some aspect of nature "flips" to a new state.

This kind of thinking corresponds more accurately to how nature works. If we are going to adapt to nature rather than have nature adapt against us, we need to learn to think in the way that natural systems work, seeing complexity, multidimensionality, contradictory aspects, and both slow and sudden changes.

Another limitation of some scientific study is a tendency to postulate an artificial barrier between "closed" systems which do not interact with the rest of the world, and open systems which interact outside themselves. The differences between these two types of systems are matters of degree, not of kind. Supposedly closed systems react outside themselves too, just at different paces or scales. There is no totally closed system, and while research can sometimes develop knowledge by acting as if a system is closed (to limit complexity and highlight which factors are most crucial within that system), science also has to recognize that such limits are limits of knowledge and research, not limits of reality.

Much (though not all) of the recent efforts to develop a science of complexity seem like these scientists are struggling to rediscover the laws of dialectics. Webs of interactions, structures of interconnection, patterns of change and interaction that replicate in natural

systems at all scales, and that replicate in human systems, communication systems, electric systems—all these reinforce the importance of dialectical thinking. These efforts are adding and integrating important related concepts such as emergence, self-organization, clusters and hubs, and providing mathematical, biological, and sociological proofs.

THE NECESSITY OF THEORY, THE PRIMACY OF PRACTICE

There are many things we don't yet know about how all the natural processes on which our lives depend will react to more carbon in the atmosphere, to rising sea levels, to changing weather patterns, to the increasing scarcity of fresh water. We have theories, many climate scientists have computer models, but none of these overrule real life. There is great uncertainty in climate science; there is much to learn before we have it all "figured out." Reality is the test of our theories, the measure of what we are doing to save our environment and how well and quickly we are doing it.

Reality trumps theory, but without theory, we have no way to understand reality. We need theory to inform us about where to start. In the process, we will make mistakes; we will discover new aspects of reality as we go.

BREAK IT APART, PUT IT BACK TOGETHER, AND UNDERSTAND TIME, PLACE, AND CIRCUMSTANCE

To understand any phenomenon, we first have to divide it, classify its constituent parts, and learn to understand which internal processes have the greatest impact. This much science has gotten very good at doing, fragmenting reality into segments and specializing in understanding the details. The trick is then to put things back together, to understand how the different parts stand in relation to each other, and even further, to understand how one particular phenomenon interrelates with and impacts other processes.

This problem has been oddly exacerbated with the rapid growth of scientific knowledge, leading to increased specialization. This has led to neglecting the essential work of generalizing and integrating the new knowledge from many fields. The truth is not only in the details, it also lies in connecting the details to the grand patterns and processes of the whole world.

We can't look at any one system abstracted from the organic natural setting in which it exists, not if we seek real understanding. To do so often means solving one problem at the expense of creating new, worse problems. Our solutions have to mesh with each other, and mesh with all the intersecting systems which give rise to an integrated series of problems. Linked systems co-evolve, so fixing one without working on the rest is self-defeating.

Time, place, and circumstance matter—they are dimensions of the interactions between systems and processes and affect those interactions. For example, there have been times when small atmospheric changes resulted in small climatic changes and other times when the same small atmospheric changes resulted in major climatic transformations.

> As climate change increasingly impacts us, we learn in new and direct ways that humans are not separate from their environment, that what we experience in one region of the world is intimately connected to what people are experiencing in other regions.

A paradox which stalled our understanding of the origin of life was that under present-day conditions, life could not have arisen on earth. It would have oxidized before it had a chance to get started. A Soviet biochemist, Oparin, showed that the present environment on earth is in part a product of life. The pre-life earth had a different atmosphere which was conducive to the start of life. But once life developed, the existence of life added great amounts of oxygen to our atmosphere, altering it in ways that facilitate the continuation of life rather than its origin.

CONSTANT CHANGE, MATTER IN MOTION

Every thing we see, feel, and experience is in a process of coming into being, maturing, declining, and passing out of existence. Everything. No exceptions. All life is matter in motion, from the internal quantum particles inside atoms to the movement of planets, even solar systems and galaxies. All changes in things and processes affect other processes and relationships.

Illustration by Sam Heimer

We observe patterns of change on the scale of human life: we all are born, mature, decline, and die. Every one of us goes through this process, unless we die before we have the opportunity to mature. Everything that humans create exhibits this progression, some faster, some slower.

Just because change is not always observable on a human time scale doesn't mean that what we see is permanent and unchangeable. Continents spilt apart from the action of the earth's crust. Mountains arise from volcanic action, thrusting up into seemingly permanent form, until, like Mt. St. Helens, they erupt again and collapse partially or completely. Rocks are worn away by water until they break up and disintegrate. No matter how permanent some phenomenon seems to be, there are internal processes going on within it, and changes due to outside pressures from its environment.

The human history of the last 10,000 years has taken place during a largely warm period in the much longer history of the earth's climatic transformations. Just because the climate and most geologic systems haven't fundamentally altered during the last 10,000 years is no reason to think the same will be true in the years ahead of us. We are now measuring the small accumulations of pressure in tectonic plates which may lead to cataclysmic geological change. Though this is not likely in our lifetime, we have to prepare future generations for the realities they will confront. Many weather and geological events that operate on cycles of thousands of years are going to happen again, even if it has been thousands of years since the last occurrence. Cycles related to the earth's orbit, tilt, and wobble operate on cycles of approximately 22,000, 40,000, and 100,000 years, and that isn't something we can change. These cycles continue to affect earth's climate, and humans can either recognize that reality and adjust to it, or ignore it at our peril.

We are starting to see and understand that evolutionary changes are going on around us all the time. Evolutionary change is accelerating even in remote parts of the globe due to pollution, global warming, changes in vegetation and animal life, altered growing seasons, etc. Evolution is not some ancient process long finished, it is an active force in today's world, even if the changes which we can see thus far are smaller quantitative ones. We know that they lead to larger, qualitative changes, even when we can't predict the exact moment of that leap.

The basic irrevocable, unchanging law of nature is that everything is always changing. The only thing that doesn't change is change itself.

EVERYTHING IS CONNECTED TO EVERYTHING ELSE – THE WORLD IS A COMPLEX OF INTERLOCKING PROCESSES

As climate change increasingly impacts us, we learn in direct ways that humans are not separate from their environment, that what we experience in one region of the world is intimately connected to what people experience elsewhere. We are learning that it is not just interesting that the earth rotates elliptically on a slightly wobbly tilted axis—these determine major aspects of our lives, affecting climate cycles and ocean currents, and dictate that global warming is having its earliest and heaviest impacts at the North and South Poles.

Pollution that is blown away is blown away to somewhere else, it doesn't just disappear. The currents in the Indian Ocean are not separate from the cycle of monsoons, are not separate from the temperature of the ocean waters swirling around the Antarctic, are not separate from the temperature in the North Atlantic, are not separate from how we heat our houses, produce our food, and transport ourselves and the goods we produce. To understand what is happening, we have to understand the chains of cause and effect, the networks of interrelationships.

Water is related to rainfall is related to ocean temperature is related to Arctic warming is related to ice formation is related to . . . and on and on. The natural world is one big web of interpenetrating processes, each affecting all the others in sometimes unpredictable ways, or rather in ways that we are not yet able to predict because we don't yet understand the nature, complexity, and multidirectional impacts of all the interconnections.

For the reason that all things are really processes and all processes are related to each other and have mutual impact, things are complicated, and we can get stuck with unintended consequences. For example, in some areas of India and Bangladesh, the UN financed the drilling of wells to help people whose lives were at immediate risk due to groundwater contamination. They did not bother to test the water from the wells, because, after all, it was natural and obviously an improvement over the stagnant water people had been drinking that was killing them, and because drilling wells had been a solution elsewhere. Only one problem—the water they pulled out of the wells was contaminated because first it drained through rocks containing naturally-occurring arsenic. Slow lethal poisoning was substituted for quick death by water-borne disease.

To consider things and processes in isolation from their real natural settings leads to mistakes. For example, when European settlers came to Australia, they found massive forests and assumed those forests functioned like the forests where the settlers came from. So they cut the forests, expecting them to grow back within a century. The problem was that appearances were deceiving—the Australian forests grew on nutrient-poor soil and had taken about 400 years to grow, rather than the 80 to 100 years that a European forest took. Once the trees were cut, the poor soil was exposed to the elements and massive erosion took place, foreclosing even the possibility of forest regeneration in many areas.

IF WE DON'T PAY ATTENTION TO HUMAN PROCESSES TOGETHER WITH THE PROCESSES OF NATURAL LIFE, WE WILL MISS SOLUTIONS AND MAKE THINGS WORSE

We can make things worse by focusing too much on only one problem, no matter how important that problem is.

For example, some scientists, and even some environmentalists, are now rethinking their stance on nuclear energy. By focusing exclusively on the excess carbon created by our energy systems, they conclude that nuclear energy is part of the solution, one way to keep producing more energy without constantly increasing the carbon load in our atmosphere (an argument being jumped on by

companies interested in avoiding the regulations and oppositional movements which have restricted the development of nuclear power plants in the U.S. over the past several decades). However, this leads people to ignore not only the catastrophic potential of nuclear accidents; they also ignore the reality that we do not know how to safely manage nuclear waste. Also, the mining of nuclear fuel exposes workers and local communities to extremely dangerous radioactivity, dramatically increasing the incidence of many types of cancer in surrounding areas.

> The world is a complex system, like a giant equation or network. The more complex the equation, the more that small differences in inputs can ripple throughout the equation, resulting in big changes down the line. This holds for both problems and solutions.

Some radioactive waste has a half-life of 4,000 years, yet it is buried in containers that will disintegrate within 150 years or less! Some already buried radioactive waste is leaking from its containers and contaminating nearby land and rivers. The recent radioactive leak in Japan following an earthquake, though not catastrophic, proves that potential dangers are not completely within human control.

It is not enough to accept the assurances of the nuclear promotion industry about safety—that has to be decided scientifically by independent sources which have nothing to gain economically from promoting nuclear power, and who consider all the ramifications for the long-term health of workers, communities, and the natural systems that will be affected.

Some point out that all industrial and energy-producing processes involve trade-offs. True enough, but we have to understand what the *real* trade-offs are to make informed decisions. If our efforts to solve global warming create massive amounts of nuclear waste, we jump from the frying pan of global warming into the fire of nuclear contamination.

Biofuels can be another example of an illusory solution. It sounds good, using naturally growing plants for energy rather than hydrocarbons. How much more natural can you get? There are just a few problems.

One is that we need all available land and water for growing plants and feeding animals in order to feed people. Second, agriculture as now practiced needs massive amounts of water, so growing biofuel exacerbates the demands on water systems—water we desperately need to feed people, to sustain us, and to sustain and replenish the land and the aquifers. Third, large agribusiness crop monocultures for growing biofuel will not only absorb increasing amounts of water (pumped by burning fuel, decreasing the efficiency of the replacement energy), they will require increased use of pesticides, will deplete the soil over some years of growing cycles and hence require more land, and this will displace rural populations.

If we jump on the biofuel bandwagon to the exclusion of other necessary efforts (improving automotive mileage, substituting mass transit for individual transport, using improved rail systems for long-haul transport of goods, researching other alternative fuels, designing cities and human support systems that aren't dependent on moving resources over great distances), we will be cutting off our noses to spite our faces.

Biofuels may have a place as one part of a system of solutions, when the raw material comes from recycling waste products like used cooking oil or waste fat from chicken processing, but not as a complete answer to the problem of rapidly depleting fossil fuels. Growing crops for fuel on a large scale is dangerous for food security, for keeping the price of basic foodstuffs affordable for poor people (this has already caused serious problems in Mexico), for water conservation, for sustainability, and for biodiversity.

Another way in which social, economic, and environmental problems are linked is that some of the poorest countries, kept that way in large part due to imperialism, are also the places which will be hit hardest by global warming. Global warming will cause more drought and famine in Africa, will cause more flooding and drought in much of Southeast Asia, will negatively impact agriculture in many countries where masses of people are barely surviving now.

CHANGE IN ONE PROCESS AFFECTS OTHER PROCESSES

When humans divert water from a river for irrigation, the river's normal flow changes, what happens downriver changes, and the amount of water absorbed by the ground changes (check out the Rio Grande). When governments decide to construct a dam to produce hydroelectric power, they consequently determine (intentionally or not) what is going to happen to salmon runs, to the fishermen and women who depend on the salmon, and to the price of salmon in the supermarket. They often unintentionally cause significant increased evaporation from the huge lakes that build up behind massive dams, wasting the very energy they are trying to capture and decreasing the total amount of water available to sustain agriculture. Change in one place in the chain affects the whole chain. When we deplete the soil or poison it with salt due to over-irrigation, the very projects set up to help our food supply also set in motion processes which will destroy part of our food supply.

When an ice field melts enough to break off and float away into the ocean as icebergs, that exposes darker land or water underneath, which absorb more of the sun's heat energy, since the ice no longer reflects as much of it back into space. Deglaciation (glaciers melting away to nothing, exposing the ground underneath) affects the heat absorption rate of the planet. This is in addition to the direct affects on water levels and the short-term cooling (from floating and melting ice) and longer-term warming (from more absorption of heat) of the ocean water.

The heat and salinity of ocean water affect its mass and also affect the ocean currents. In the North Atlantic, cold, more salty, heavier water sinks to the ocean floor, drawing warmer water north, which is a major engine of global ocean currents (the "conveyor"). We are seeing signs that this ocean current system may shut down soon. Without warmer water being drawn north, Northern Europe will get much colder on average, even as it experiences hotter summers (another hotter/colder climate paradox). One problem with prediction is that heat in the oceans lags atmospheric heat by several decades, so even if we stopped all human creation of atmospheric carbon today, the oceans would continue to warm for several more decades.

Everything is always changing, and every change ripples throughout the interconnected natural systems. Each change affects humans and their systems because we are dependent on nature for our existence. For example, when humans over-fish a fishery system, we increase the retail cost of the shrinking supplies of fish, drive fishermen and women out of business, decimate the economies of fishing villages, destroy a formerly renewable source of the protein humans need, and alter the ecological balance of that region in unexpected ways.

ALL PROCESSES CONTAIN STRUGGLES WITHIN THEMSELVES; THOSE STRUGGLES ARE THE MOTORS OF CHANGE

As Richard Levins and Richard Lewontin say in *The Dialectical Biologist*, "Things change because of the actions of opposing forces on them, and things are the way they are because of the temporary balance of opposing forces." The contradictions within processes drive development, and all processes are unities of opposing internal forces, struggling against each other but also mutually dependent.

Within the atmosphere of earth, there is quite a bit of naturally occurring carbon. Without carbon, the earth wouldn't hold on to enough of the sun's heat for us to survive. We need carbon in the atmosphere. Maintaining the balance of carbon relies on the actions of many different systems, some of them opposites. The atmosphere is dependent on processes which create carbon, processes which absorb carbon, processes which store carbon, and process-

Adrian Dennis/AFP/Getty Images

◀ A campaigner dressed as a polar bear in Grosvenor Square near the US Embassy in London calling for world leaders to act urgently on climate change.

es which transform carbon. Trees inhale carbon and exhale oxygen, so the processes of forests and whether they are growing faster than they are being cut down affects the amount of carbon in the atmosphere. Oceans capture carbon in various ways, and store it in various ways—in the water, in the shells of living creatures, in the collected shells of dead creatures, to mention a few. Many things can change the ability of the oceans to absorb more carbon—the amount of salinity versus fresh water, ocean currents, and temperature, to mention some. How much land is covered by growing plants, how much by paving, how much by forests, how much by ice, all struggle and interact to contribute to the amount of carbon in the atmosphere. Major changes in any of these interlocked systems affect all the other parts as they penetrate and impact each other.

We need carbon, but too much carbon can make it too hot for us. Too much can trigger enough heat that the permafrost starts to melt, which will lead to more carbon being released into the air, making a feedback loop that could lurch beyond any possibility of human control. Too much can upset balances on which life depends.

One of the greatest weaknesses of human life, our dependence on natural circumstances partially beyond our control, is also our greatest strength, due to human ability to adapt to most circumstances we have been confronted with. *But that adaptability is not without limit.*

There are numerous examples throughout history of environmental crises forcing large-scale human change. Aboriginal Easter Island, Norse Greenland, the Roanoke Colony, and many successive Mesopotamian agricultural societies were either destroyed or forced to move when their environment changed, either from natural causes like the Little Ice Age or multi-year drought, or due to human causation, such as soil depletion, erosion, or over-irrigation.

More urgently, the adaptability of human social systems is more limited than general human adaptability. When oppressive, class-divided societies are stressed, whether by war, economic crisis, shortage of resources, or impending environmental collapse, the ruling class first transmits the main burdens of that crisis to the oppressed classes, using money and power to escape the consequences as long as possible. So the crises that threaten us are not just environmental, they are also crises of our social and economic systems. They will accelerate social and economic problems, generating more social instability and conflict.

Global warming leads to warmer temperatures, but it also leads to more extreme weather, more intense storms, even to more snowfall in some places. Process and change are not unidirectional, they can exhibit as opposite phenomena resulting from the same change—more rainfall, more floods, *and* more droughts.

Another pattern of change is periods of experimentation as tipping points get closer (and sometimes increased efforts to stop change and reassert the old balance). The qualitative leap is then often followed by specialization, by successive adaptations to the new balance.

TIPPNG POINTS CAUSE REVOLUTIONARY LEAPS: CHANGE IS BOTH REFORMIST *AND* REVOLUTIONARY, SLOW AND STEADY BUT WITH PUNCTUATED LEAPS

Pomchai Kittiwongsakul/AFP/Getty Images

▲ **Activists in Bangkok, Thailand march in front of the headquarters of the Japan Bank for International Cooperation (JBIC) to protest against bank's financial backing of coal industry in Thailand which is contributing to community displacement, pollution and climate change.**

The phrase "tipping point" is the current jargon of choice when discussing the potential of major sudden changes in our environment. All "tipping point" means is that points come in every process when a leap to a new state, a new balance, is made—a principle of dialectics, known as the transformation of quantitative change into qualitative change.

Stephen Jay Gould, noted evolutionist, described this phenomenon of tipping points as "punctuated equilibrium." He observed the slow accumulation of changes in species, the slow development of small genetic changes, which then on reaching a tipping point (combined with ecological and climatic changes) burst forth as if from nowhere into massive genetic changes in a relatively short period of time, historically speaking, such as happened during the Cambrian Explosion. When a system is in general equilibrium, it is actually in a state of creative tension during which the pressures for change build up.

Other sciences have other jargon to describe this pattern—phase transitions, hinge points, event horizons, threshold effects. They all describe similar aspects of phenomena, observed virtually everywhere, except where we haven't studied deeply enough yet.

Earthquakes are another example of quantitative change leading to qualitative change, driven by contradictory forces—opposing tectonic plates push against each other, building up great force and tension, until a quake releases that pent-up energy in a massive realignment. Then the process starts over again. This cyclical, repetitive transformation never returns the plates to exactly where they were before the quake, and which fault lines are under most pressure shifts, creating new and still unpredictable quakes in different areas.

NATURE WORKS SLOWLY AND INCREMENTALLY, *AND* IT WORKS SWIFTLY AND DECISIVELY.

Some of the models that scientists are developing to help understand global climate change are flawed. They focus on quantitative, protracted, linear changes to the exclusion of looking for tipping points which could cause big, quick changes in the atmosphere, in the oceans, in the formation or loss of ice fields. If we ignore either the slow accumulation or the dramatic shifts, we will develop flawed solutions based on flawed understanding.

The sky is not falling, and the world economy won't collapse tomorrow, or the day after tomorrow. But it is foolish to ignore the possibility that we could overload nature past the point of no return for the conditions humans require, especially when many, many signs point in that direction already. Based on the slow incremental accumulation of small changes, all systems, natural and social and economic, reach tipping points when they transform to fundamentally different systems. It happened at the end of each ice age, it happens to mountain ranges, it happened with slave systems, it happens to tectonic plates, it happened with feudalism, it happened to empires, it happened to agriculture in some areas which through over-farming and soil depletion (along with changes in weather systems and rainfall) became deserts where rich agriculture had existed, like the ancient Mesopotamian Fertile Crescent, much of North Africa, the Mayan Yucatan, the Midwest Dust Bowl, and parts of the Nile Valley.

Archeological discoveries about ancient societies in the Middle East show cycles of settlement followed by abandonment, followed by resettlement in some cases. For instance, there was a widespread desertion of cities in Mesopotamia around 2200 B.C. following weather changes, drought, and soil depletion. Some of the causes came from weather systems beyond human control, other causes were the direct result of human agricultural practices.

THE WORLD AS A SERIES OF GIGANTIC FEEDBACK LOOPS

We can study the arctic glaciers as they are affected by global warming, learning how and when they will melt, break up, and at what pace. This is an important aspect of the additional scientific research we need.

But if we study these in isolation, we make a big mistake. If the ice melts, other things happen as a result. When major sections of the poles begin to melt, more of the heat which ice reflects back into space is instead absorbed by darker water, land, and vegetation, increasing the heat absorption of the earth. In turn, this can accelerate the melting of huge areas of permafrost.

If we just look at the permafrost, we can pretend that the possibility of growing food on defrosted land will absorb all that additional carbon. But once begun, this melting will emit more carbon, escalating global warming, which will melt the permafrost further and faster as a result, and on and on. There is no end to the ripple effects. If all the fresh water contained in glaciers and ice fields, like those on Greenland and Antarctica, is released into the oceans, that can result in the quick rise of sea levels by several hundred feet, swamping many cities built near the water (not soon, but that's the direction things are headed). All that fresh water also changes the density of water, which can change the ocean currents, which can disturb the process of monsoon activity in South Asia, which can result in no rain for crops, leading to mass famine.

Glacial melting can have other effects too. As a glacier melts, it loses a massive amount of weight. The decrease in glacial weight eases pressure on the tectonic plates far underground, making it easier for them to move. This results, as is already happening in some parts of Alaska, in increased earthquake activity. Global warming doesn't *directly* cause more earthquakes, but it contributes to conditions that result in more earthquakes.

Similarly, it seems as if global warming, while not increasing the incidence of hurricanes, is contributing to the increased intensity of hurricanes. Not only are hurricanes gaining in intensity, they are impacting land that has been increasingly deforested, paved, eroded, and otherwise robbed of natural protection against the effects of storms, further amplifying the impact on farms, animals, hillsides, rivers, towns, and people.

Once a major global process reaches a tipping point, there is no turning back, not on a time scale needed by humanity.

NEW STATES OF BEING, OF RELATIVE EQUILIBRIUM, NEGATE PREVIOUS BALANCES

The climate of the earth has "flipped" from one state to another numerous times over the millennia it has been in existence. Warming periods followed Ice Ages, and were in turn followed by Little Ice Ages, followed again by relative warming. While within each period there were significant variations in temperature, once a certain tipping point was reached the main climate systems transformed into a new balance, a new relative equilibrium. Each of these transformations was not only of temperature, but also of ocean currents, sea levels, ice formation, precipitation, and other linked phenomena. These changed conditions led to changes in vegetation that affected regional climates and even human agricultural development. As these systems flipped, they reached a new balance, one fundamentally different from the previous balance, negating it. And in time, the new balance was itself negated and transformed.

This process affected the development of humans, affected where and when humans were able to begin the processes of agriculture and domestication of animals. And now, the development of humans is challenging nature's ability to find a new balance compatible with human existence.

Even without human intervention, the planet has gone through

major changes from one state to another. The danger is that the results of human activity (burning hydrocarbons, depleting rivers, creating pollution, depleting soil) will push nature's processes faster and more decisively to shift to conditions that humans can't survive well under, if we can survive at all.

Nature *will* survive. Nature *will* reach a new equilibrium. That is not in question. The earth has been through many more cataclysmic changes than global warming will bring. The question is whether or not our species will be able to survive that new balance. And if we are, will that new balance be compatible with developed human existence, with the existence of human sustainability at a level of technological advancement and agricultural and water sufficiency.

We don't know the answers yet. The challenge is: are we willing to do what it takes so that we stop playing dice with all other aspects of nature for the benefit of the few, the rich, the exploiters? Will we continue on this path which is transforming the relationship of humanity and nature in ways that harm humanity? Or will we find a new path?

INTERNAL AND EXTERNAL CAUSES

You can swat a fly with a flyswatter, but it is a very different matter to use that flyswatter to hit a rhinoceros.

Whether or not a rock breaks when force is applied to it depends both on what kind of rock it is and how brittle it is, and also on what kind and size of force is applied to it. The same amount of force that breaks one kind of rock may leave another kind unscathed. To understand any process, we have to know its internal makeup, know what pressures it is subject to, and also know what pressures that process subjects its environment to. Learning about the interaction of internal and external causes provides real understanding.

Human life and societies also contain such internal and external causes and interactions. History does not consist only of wars and invasions, for example, but it does include them. Outside pressures force reactions, but how a country responds has also to do with internal pressures, struggles, and contradictions.

Whether or not a strike is victorious depends on the workers and their level of organization, determination, and alliances, but also on the financial state of the company, on its corporate culture, and on the reading of the general political and economic situation by both sides. A strike that inflicts financial damage to companies to the tune of billions of dollars usually wins, but several years ago, the grocery strike in Southern California inflicted that much damage but the companies were prepared to pay the price, due to the competition they expected from Wal-Mart (and Wal-Mart's less expensive and less humane—and most often non-existent—health care benefits). So the companies refused to change their contract proposals, hired (very expensive) substitute workers (scabs), and paid the price of a massive amount of lost business. By all standard measures, the union and workers should have won, but instead they were forced to accept a contract with some serious concessions, including a two-tier wage system. Such struggles need dialectical understanding, not only arithmetic calculations.

SCALE MATTERS

For many centuries, few thought that the continents were once connected, because no one had seen continents move. We didn't yet know how to measure continental drift; we didn't even know there was such a thing. Continents were looked at as separate from each other, because humans didn't yet understand the history of geological change. When we look at the transformation of continents, we are talking about a scale of hundreds of thousands or millions of years, and periodic rapid change over "shorter" periods of hundreds or a few thousands of years. Compared to the time scale of human life, such change seems like it takes forever. Only relatively recently have we started to be able to measure the small changes which in time lead to fundamental transformations. We have begun to understand that these transformations include long periods of slowly accumulating changes and fast periods of cataclysmic change.

Scale matters, too, in the nature of the different ecological

problems we face. A rapidly rising sea level would be disastrous, would harm innumerable humans, but is something humanity could recover from. It is even something we can ameliorate the worst consequence of by preparing and changing now. But fundamental alteration of the atmosphere has the potential to challenge the existence of our species. If the air becomes too polluted for human health, we can't simply breathe something else.

You can't get rid of cockroaches in a single apartment—you have to tackle a problem at the scale on which it exists. This is why regulatory reforms that aim to limit pollution one factory at a time after it has already been produced are at best stop-gap measures, and at worst just public relations efforts to justify continued production of pollution.

When a set of problems has an array of causes, then a coordinated set of solutions is required. Small changes in the personal habits of a few people won't help much. Market solutions such as "trading pollution credits" (also known as "cap and trade" programs, advocated by Al Gore and many others) are counter-productive unless part of a comprehensive program of solutions. Otherwise, they are just a fig leaf to let companies claim they are "paying the price" while continuing to create more pollution. Such programs can slow the increasing rate of creating pollution but will never result in ending pollution or excess carbon-burning.

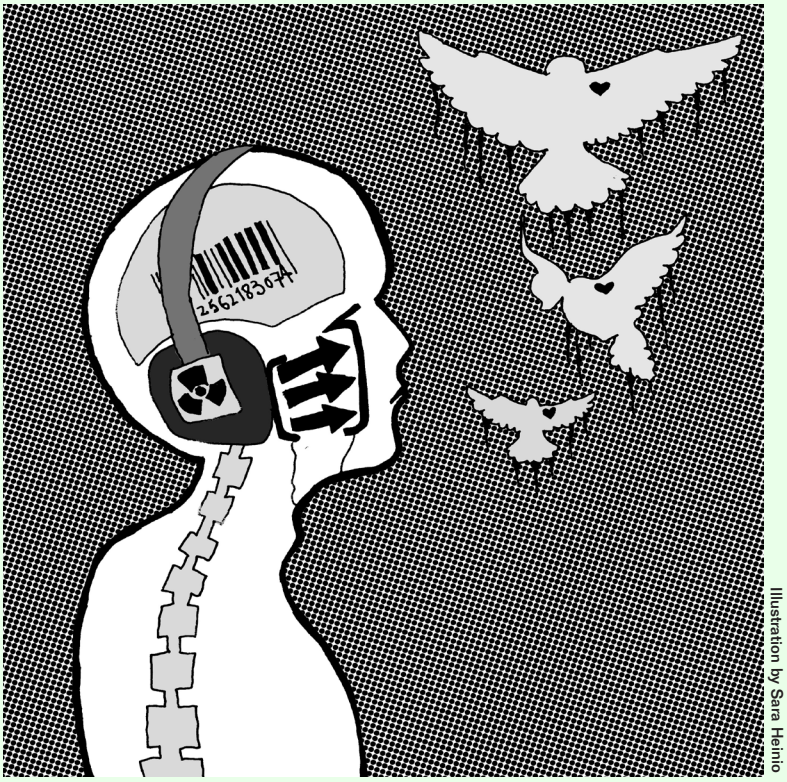


Illustration by Sara Heinio

The world is a complex system, like a giant equation or network. The more complex the equation, the more that small differences in inputs can ripple throughout the equation, resulting in big changes down the line. This holds for both problems and solutions. The more solutions we put into place, the more we will learn; the more we work at improving all the factors we possibly can, the better chance we have of avoiding the natural cataclysms that otherwise await us, from intensifying storms to rapidly rising sea levels. We have to build in our own feedback loops, so that we can measure and monitor how our predictions and solutions are working in the real world, and so we can constantly adjust them if and when we are mistaken.

> The interactions between human-driven climate change, water overuse, and overuse of soil can overwhelm the ability of natural systems to support human and animal life, first in areas that have long been subject to these pressures, then in a more generalized fashion throughout the world.

Scale matters when we talk about the part that individual humans play in global climate change. On the scale of an individual day in an individual life, it doesn't make much difference if someone drives or doesn't drive, if someone composts and recycles or just throws everything into the trash. What one person does on one day makes little difference, but when combined with the actions of all other human beings, the cumulative impact is huge.

The same can be applied to measures to solve environmental problems. My using a little bit less water or driving less or buying a more efficient car will not help much by itself, but if we change production, sales, distribution, packaging, and education to help millions do the same, the total will make a tremendous positive difference. We won't get very far if we leave it on an individual basis only, but if we connect individual efforts with social and economic changes, we have a much better chance of making serious progress.

FORM AND CONTENT, APPEARANCE AND ESSENCE

While content is more basic than form, there is a constant interaction between the two, in which form determines limits and choices for content. Form also often resists change from smaller quantitative accumulations (the resilience of a system measures this), until a qualitative leap forces changes to both form and content. For example, in massive global systems like ocean currents, there are huge amounts of inertia which slow down change. But for that very reason, once basic change starts in these systems, it is very hard to stop.

What we see on the surface of things is rarely fundamental truth, so appearances can fool us. For example, in 1816, there was a volcanic eruption that spread a dark cloud of particulate matter over the earth, causing a cold "year with no summer." That could happen again, driving temperatures down, making it seem that the earth was no longer heating up. But most such one time events don't change the course of climatic developments, at least not permanently (there are a few important exceptions). Even while global warming is going on, there may be short-term reverses, clouding the issue. We have to distinguish the surface appearances from the underlying developments. Both affect us, but the underlying developments affect us for much longer and in more basic ways.

IT'S ALL CONNECTED, INCLUDING HUMAN SOCIAL SYSTEMS

It is impossible to seriously consider solving the problems facing millions of people in Africa without looking at all the major factors affecting them, including: increased drought in many places, accelerating urbanization without adequate municipal systems (water, sewer, etc.), the AIDS crisis, crushing international debt, deformation of development driven by the policies of the World Bank and the IMF, the massive transfers of wealth to international banks over many decades, the drive to control resource-extraction by multinational corporations, rising ocean levels and water temperatures, excessive demands on limited water systems, the legacy of colonialism which encouraged and depended on intertribal rivalries and warfare to control vast populations and which imposed artificial borders, massive poverty, and internal and external refugee populations. All these are linked together. None of them can be solved in isolation, without simultaneous actions to solve the others. Human problems, economic problems, and environmental problems are not separate.

Too much of the discussion of global climate challenges is limited in an odd way. The problems are seen as problems of natural systems (which they are) or as problems in need of technological solutions (which they are). But little is done to connect any of this to the type of economic and social system people live in. In capitalism, when we collectively face problems that need collective solutions (and it doesn't get much bigger or more collective than global climate change, both on the problem side and the required solution side), we run into the problems of private property (private property in factories and agribusiness, not personal property such as homes and personal possessions) and private decision-making about land, production, resources, and capital investment. Private property decision-making ignores social health and welfare in its calculations, resulting in profitable but harmful production (and unnecessary excess waste).

We can't afford to wait. We must make a start right now, even given the capitalist system's domination of the world's economy. We can: change accounting systems to include so-called "externalities" in corporation profit considerations, adopt the Chinese-initiated "green GDP" calculations, adjust tax rates on polluting companies, adjust prices of goods to include the costs of disposal, grant tax credits to companies that adopt large-scale environmental improvements, change industrial processes to eliminate the production of pollution (in some cases creating more profit in the process), use public pressure campaigns to force corporations to change practices such as over-cutting timber and anti-union campaigns. These are steps we can work on now. Anti-sweatshop campaigns, corporate accountability campaigns, NGO-sponsored international boycotts against environmentally-destructive corporate practices, restrictions on the free flow of capital to evade labor and environmental standards, all will help. Simply enforcing existing U.S. environmental

regulations and laws would help, especially if the EPA is funded to hire enough investigators to do the necessary enforcement.

Trading elimination of international debt in return for maintaining existing rainforest stocks is one innovative idea. Though the rainforests of the Amazon, Siberia, and Indonesia are a resource for the whole planet, the people of the whole planet do not pay for the resource. So those who live in and near the rainforest, stuck in dire poverty, are forced by bitter, immediate necessity to cut down trees for charcoal, clear land for farming and housing, and sell to large corporations who cut forests and bulldoze massive amounts of land for grazing cattle. If we find a way to compensate the people who live there for maintaining the resource for the benefit of the whole planet, we can change the equation that now works against the rainforests.

Each of these steps can contribute to the solution. But the problems are fundamental, so the solutions need to be fundamental—Band-aids and antiseptic creams can't cure cancer. Solutions to collective problems must be collective solutions. Solutions to worldwide problems must be worldwide solutions.

Such solutions require marshalling all available resources, because of the scale involved—massive capital investment to redesign industry to end the production of greenhouse gases and other pollution, huge outlays to alter our agricultural systems to use less water, waste less soil, feed local populations first, change to more sustainable, labor-intensive, organic, less monoculture farming. At least at first, these investments are not going to be profit-making; *they are just necessary for human survival*.

Even when changes will be profitable in the long term, that is of little interest to capitalist investors who only see more destructive opportunities because they result in short-term excess profits. Sooner or later, all non-renewable resources are going to run out, so we need to begin to slow down the rate at which we are extracting them; that is simple common sense. But what we see instead is increasing rates of extraction, because that pays off more in the immediate future. This is pennywise but pound foolish, and capitalism thrives on this approach (temporarily) because the immediate profits go to a few, while the long-term costs are borne by the many.

The capitalist system is an obstacle to the solutions our survival requires. Only a system that puts the needs of people and nature ahead of profits will ultimately work, a system that uses the human measures of survival and the greatest good for the most people, rather than the short-term profit of the few at the long-term expense of everyone, including the capitalists themselves. We need humanitarian ways to measure social and economic progress, rather than using "the market" and only the market as an all-encompassing framework, because that imposes limits incompatible with many of the changes we need to make for human survival.

> Everything is always changing, and every change ripples throughout the interconnected natural systems. Each change affects humans and their systems because we are dependent on nature for our existence.

As with fundamental solutions to other problems such as racism, inequality, economic exploitation, and others, socialism is a necessity for the survival of the human race—not a guarantee, but a necessary precondition for the kind of thoroughgoing, basic solutions humanity needs.

A socialist system of economic, social, and political change is also necessary because without it, our countries and economies will become more unequal as they come under more stress from changes in nature. Without justice and equality for all, this will lead to social cataclysms, to destructive warfare, to repression. It will lead to battles over water that destroy water, battles over food that destroy food, battles over fossil fuels that destroy some of the limited fossil fuels left, battles over land that destroy the agricultural capacity of the land.

For example, a recent UN report says, "Competition over oil and gas reserves, Nile waters and timber, as well as land use issues related to agricultural land, are important causative factors in the instigation and perpetuation of conflict in Sudan." Flooding, deforestation, overgrazing due to explosive livestock growth, and decline in rainfall caused by regional climate change have been stress factors. It continues, "Long-term peace in [Northern Darfur] will not be possible unless these underlying and closely linked environmental and livelihood issues are resolved."

Socialists also need to understand that if capitalism does a thorough job of ruining the environment, then the material basis for socialism will be harmed or destroyed.

PROBLEMS OF SOCIALISM

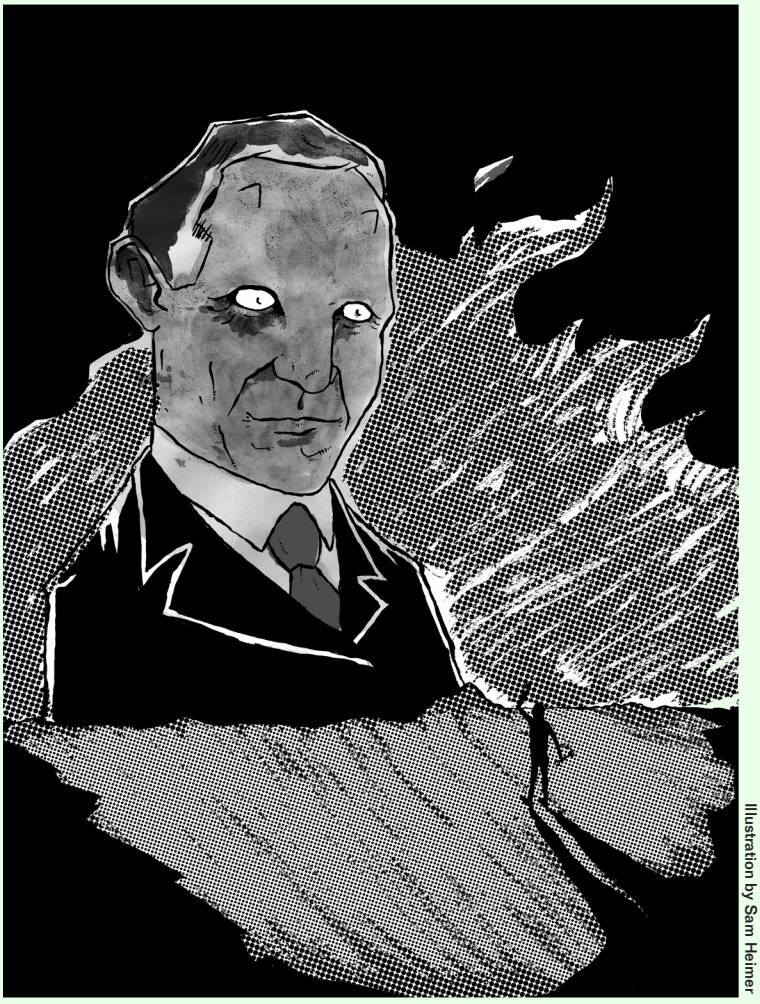


Illustration by Sam Heimer

Socialism, the collective ownership of and collective authority over the means of production, is a necessary, essential aspect of the changes we need to make to protect the survival of our species, but it is not a sufficient condition by itself. Socialism is necessary to mobilize the resources of whole societies to fund the massive changes we need to make, to change the measures of progress and development, to put people and nature before profits. But just because socialism *can* do that doesn't mean it *will*.

Some examples will illustrate both sides of this issue.

In the Soviet Union, a notable environmental success was the eventual clean-up of Lake Baikal in Siberia. Polluted by several paper-making plants, a struggle resulted in returning the lake much closer to its pristine condition. That illustrates what is possible, making changes in production, in the placement of factories, in the redirection of waste disposal, in social control of natural and industrial systems to create harmony and progress. Since capitalist restoration, there have been continuing struggles to keep new development away from the lake, the largest freshwater lake by volume in the world.

The Soviets also used urban design to promote much greater use of mass transit, to implement "green zones" around cities, and to separate industrial zones from housing in many places.

The opposite is illustrated by what the Soviets did to the Aral Sea, building massive irrigation projects, dams, and canals to drain the rivers that fed the Aral Sea. Once the world's fourth largest inland sea, it has now virtually disappeared. Water diverted to grow cotton in the desert resulted in the ground becoming inundated with salt, destroying the ability of the land to grow cotton and creating large desert areas. The calculations were short-term, linear, and not holistic. A short-lived economic boom led to long-term negative consequences, destroying rather than creating value.

Another positive example is Cuba's environmental progress. Begun on a large scale of necessity in the early 1990s, Cuba now has arguably the world's most advanced and comprehensive recycling system, is engaged in innovative scientific research into the environment, has transformed much agriculture to organic farming methods, has created more small-scale integrated farming and moved away from monoculture farming, has mass popular education about the ecology of their island nation, and plays an important role in the world debate about the nature, scope, and depth of the crises we face. Cuba has also, over several decades, increased the amount of the country which is forested from 15% to 25%—Cuba is the only country with a net increase in forested area in recent years. Cuba's planned responses to natural disasters, such as the

hurricanes which regularly hit the island, are world models. Successful experiments with urban agriculture, with community health, with local democratic organization, and with international solidarity are all world pacesetters.

Though some scoff because the Cubans started getting serious about the environment on a large scale only when their economic situation forced them to, this is no different from the situation facing the entire world now—our economic situation is increasingly forcing us to confront and learn to solve environmental problems. Even some capitalist corporations, like insurance companies, are already feeling the pain of global warming climate changes and increased storm intensities. We are reaching a point where the whole world will be forced to make adjustments, so we are no better than the Cubans, who have the virtue of having pioneered the changes that are necessary for the whole world to make.

Socialism has been hampered by the necessity of wasting resources and human capital on armaments to protect itself against imperialist attacks, by attempts to take short-cuts to development by adopting technology designed for capitalist economies, and by an unnecessary preference for large-scale projects with large-scale impacts even when those impacts are largely unknown and potentially negative.

We should also note that in virtually every country where capitalism has been restored, the result has been sharper and more destructive assaults on the environment and on the living and health standards of the vast majority of people.

There is much criticism about pollution in the former socialist countries of Eastern Europe and the Soviet Union. There are several major things wrong with these arguments. First, some of the problems were the result of a rush to industrialization, caused in part by imperialist economic and military pressures and threats, distorting development and resource allocation. They were not problems inherent in socialism.

Second, one method used to rapidly industrialize was to adopt unchanged capitalist industrial equipment, machinery, and processes. These were designed for capitalist production that didn't have to pay for the disposal of the waste it generated (among other negative features), so its use by socialist countries smuggled in destructive unintended results. In some cases, the rush to industrialization exacerbated these problems.

Third, the environment (as well as the living conditions for the vast majority of people) has gotten significantly worse since capitalist restoration. So even though there were serious problems, bringing back capitalism is going in the wrong direction to solve them. For example, Siberian forests are now being cut at a much accelerated rate by Western timber companies, and this is nearly as destructive to the world's ecosystem as deforestation in the Amazon.

Fourth, the effects of driving millions of people down into subsistence survival makes solving environmental problems more difficult, stressing both human and other natural systems to the breaking point. When people live in grinding poverty, of course their focus is on immediate survival issues, not on how to do what is best for the planet in the long run. Since the transition back to capitalism happened, in those countries the numbers of people living in extreme poverty went from around 14 million to over 168 million in the space of a few years, all while creating a handful of multibillionaires. As Mike Davis notes in *Planet of Slums,* this constituted "an almost instantaneous pauperization without precedent in history."

CHINA

China illustrates the dangers when socialist planning downplays the natural consequences of development. China as of yet has no conscious, comprehensive strategy for an ecologically sustainable development path, or for a new socialist relationship with nature's need to reproduce itself (and humanity's need to let nature reproduce the natural systems we depend on).

China's development plans include massive irrigation projects (truly massive) which threaten large ecological systems, and large-scale construction of very polluting coal-burning electricity-generating plants. By some point in the not-too-distant future (likely within a

year or two), China will pass the U.S. as the single largest producer of greenhouse emissions (on the basis of total output, though still far less on a per capita basis—Australia and the U.S. hold the distinction of the highest per capita emissions). As well, much of China's increasing pollution is due to industries that export to the United States, meaning that U.S. corporations are also responsible, not just the Chinese.

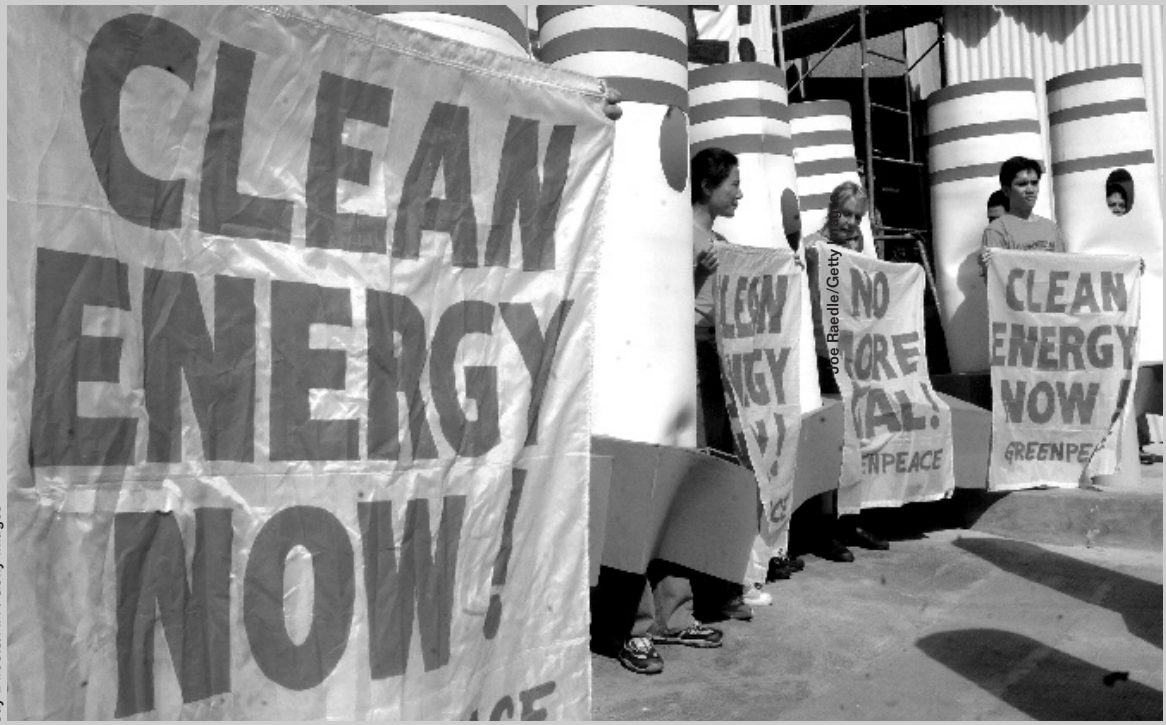
Pollution from coal-fired plants, dust blown from eroding agricultural land, and increasing automotive transport work together to pollute the air in Beijing so much that an almost permanent haze covers the greater urban area, much like Los Angeles. That is part of the truth, one that China "officially" doesn't understand as having significant negative long-term consequences for the health of the Chinese people who daily breathe that polluted air.

China's official position on the steps needed to address global warming is, in many ways, identical to the position of the Bush administration, plus a couple of wrinkles. China, like Bush, opposes any and all mandatory standards. Like Bush, China currently claims that in the "balance" between environmentally necessary improvements and economic development, unrestrained economic development is the factor that outweighs all others. China also cites uncertainties about the exact consequences of global warming as if that justifies postponing serious action.

The wrinkles have to do with the correct argument that U.S. and western European industrial development over the last 150 years has added the most, by far, to greenhouse gases, and the people of China and other less-developed nations have been cheated out of their share of the benefits of that development. Therefore, they argue that China, among others, should not have its development restricted by having to match restrictions imposed on most developed countries.

There are several problems with this reasoning. One is that it offers only two alternatives, either everybody engaging in unrestricted polluting, or some (the less-developed countries) not being subjected to any mandatory restrictions. These are not the only two alternatives. It is possible (though difficult) to construct a sliding scale of mandatory standards which takes social factors and development levels into account.

Another problem is that nature is letting us know in no uncertain terms that the development path which Western Europe and the U.S. took is not available to other countries, not without hurting everyone including the vast majority of people in the less-developed nations themselves. All of humanity needs developing countries to take a different path to industrialization; just creating more of the



Jay Directo/AFP/Getty Images

Joe Raedle/Getty

◀ **Activists in Manila, Philippines protest at the Asian Development Bank (ADB) to stop financing climate change in Asia and for contributing to the destruction of ecosystems in the region.**

same will not help the Chinese people in the long term, nor the people of other less-developed nations. All of humanity *also* needs the U.S. to transform its industrial production and transportation systems (if the U.S. just cut back its carbon emissions to the level of Western Europe, that would make a significant contribution to buying time for the whole world). It is not one or the other, it is both simultaneously.

> Some doomsday scenario predictions have failed to materialize, which tells us that real life practice is both more complicated and more fundamental than our theories.

What we don't always see in this country are the struggles going on within China, nor the positive efforts they are making, such as large-scale reforestation programs, innovations such as green rooftops, planting tree barriers to decrease wind-blown particulate matter in Beijing, and efforts to at least slow desertification of agricultural land. No matter their official position for international diplomatic purposes, there are many Chinese scientists and political activists (including within the Chinese Communist Party) who argue for a more realistic approach to development, one that takes the environment into account much more decisively.

We also don't see, behind the massive projects like the Three Gorges Dam, that there are many smaller-scale positive projects, such as investment in mass transit and experiments with new "green" cities. If nations adopt the Chinese-developed "green GDP," that will help make clear the real costs of environmental problems. In another positive step, China is banning production of CFCs, which harm the ozone layer, phasing them out by 2010—while this is late, it is the right step to take and we should applaud it. In spite of the plans to build many more coal-fired electricity-generating plants, China has committed to working to get 20% of its energy from renewable sources.

We also don't always see that even though China is on the negative path to producing many more automobiles, they are already adhering to much stricter, higher emissions standards than U.S. automakers.

However, more automobiles mean more highways, roads, and parking lots, taking land away from food production, stressing energy resources even more intensely, creating more pollution, causing water run-off and erosion problems, draining resources from other kinds of construction and production. This results in the creation of more problems, and more extensive problems, rather than real solutions.

One problem of reaching the right balance between development and sustainability is that benefits from development can occur rapidly, while the negative consequences can sometimes take much longer—it takes time for toxic chemicals to accumulate and concentrate in water and soil, for example, time for them to concentrate up through the food chain, time for the negative effects to show up in the health of people, and more time to correctly diagnose and address the underlying causes of the problem. During that time, toxic chemicals continue to accumulate and impact the health of more people, making remediation more difficult.

Continuing aspects of economic planning could enable China to marshal the resources of the entire society to tackle social and economic environmental problems on a scale unimaginable in the capitalist U.S. If China finds ways to enforce their reasonably good environmental laws instead of letting both state-owned companies and capitalist enterprises run roughshod over these laws, both the Chinese people and the world would benefit. If they use their power to tackle global climate change challenges, China has the potential to lead the way, rather than excusing their way to making the problems worse.

To condemn China by ignoring the positive is as counter-productive as praising the positive while ignoring the negative impact China is already engaged in or planning. Both contradictory aspects are part of reality. We need to understand all of reality in order to make the best decisions, and in order to make the best and most persuasive case for serious, decisive action to transform humanity's relationship with nature.

THE EXPANSION OF THE SOCIALIST IDEA

If socialism is necessary but not sufficient, what more is needed?

Contradictions are not just between exploiters and exploited. There are many contradictions and tensions between humans and nature, and socialism doesn't make those disappear—those contradictions will still drive struggle and change, though not class struggle. As well, uneven development is a reality of all change, and that by itself can result in contradiction and conflict, and neither socialism nor communism will change this.

While socialism will make possible the massive changes we need, that is no automatic guarantee that the right choices about what to do with limited resources will be made. We also need education, democratic inputs from popular struggles, independent environmental organizations, much more scientific knowledge on which to base sensible decisions, and a deeper understanding of the interrelationships between land, water, weather, agriculture, industry, and society. ***Planned economies need to include nature's requirements in their plans***.

Marxist economists pay great attention to the necessary balance between production of consumer goods and the production of the means of production. These concepts have to be expanded to include the restrictions of limited natural resources (the finite amounts of coal, oil, natural gas, etc.), the requirements of nature to not be so overloaded that it can't absorb waste products, and the necessary balance of planetary temperature systems.

The greatest good is *not* the greatest amount of material goods, but rather production of material goods in balance with the continual reproduction and restoration of the natural conditions we need to survive. The natural world we live in is not infinite, and the resources in and of nature are also not infinite. We need sustainable socialist ecological development, rather than development which depletes the soil, depletes natural resources, paves over the land, and focuses on immediate gains while ignoring long-term costs.

Socialism is about ending hunger and poverty, about creating health care, jobs, equality, peace, international cooperation, an end to the exploitation of human labor for private profit, and about planned social and economic development, but *it must also include what is healthy for the environment*. If we destroy the ability of natural systems to regenerate and recuperate, we destroy the possibility of health for humanity. ***We can't have healthy humanity without a healthy natural world.***

Ultimately, problems and shortcomings of socialism result from a failure to think, research, plan, and implement dialectically and democratically. Economics and development are ultimately based on the ability of nature to regenerate itself, based on maintaining a healthy balance between human needs and the needs of the natural systems humanity depends on. If development doesn't work to maintain that balance, it works against the healthy survival of humanity, and that is as true of socialist development as any other kind.

While we can find in Marx and Engels many references to the necessity of basing ourselves on the imperatives of the natural world, most socialist planners subordinated these to the imperatives of increased production, increased industry. Where the two came into conflict, industrialization won out. The history of the early Soviet Union contains many important environmental laws and attempts to maintain a healthy balance between nature and industry, but most environmental thinking was another victim of the Soviet leadership's drive towards rapid and large-scale industrialization, driven in large part by capitalist invasion, encirclement, and embargo, and by the looming fascist threat from Germany. Objective needs and objective pressures contributed to over-centralization, and that buttressed Stalin's personal power, leading to other mistakes and to crimes against people, nature, collective leadership, and against socialist legality.

Unlike so-called "deep ecologists" who argue for ignoring human needs to let nature triumph, and unlike limited socialist thinking based on fallacious assumptions of "man's triumph over nature," we need a rounded, all-sided, in-depth understanding of the interrelationships between human and natural systems.

In the field of environmental struggle, it is the responsibility of Communists, Marxists, labor leaders, and working class activists,

to provide leadership, as in other fields of struggle. It is not enough to be right in the abstract, or to have excuses, even valid ones. We have to be active participants. This is the unity of theory and practice—we won't get the theory right unless we are involved in action, in struggle. It is not only "the masses" who learn in the process of struggle, it is everyone including Communists, whether in power or not. We have a responsibility to lead not only the working class but all movements and mass organizations into action against the accelerating capitalist destruction of the environment, in our own interests and in the interests of humanity as a whole.

Part of that leadership is also to critique our past errors, mistakes, and limitations. Marxist economics divorced from the natural world leads to distortions and problems. We have to merge our theory and practice with current science and with current and future environmental limitations on extraction, production, and distribution. We have to understand that previous socialist ideas about boundless and ever-increasing production of goods will not work in the real world. We have to develop our theory to adapt to today's deeper knowledge of environmental limits.

Another part of our unique leadership comes from understanding how every progressive struggle that limits capitalist power contributes to solving environmental challenges. Our ecological crises will be solved not only by direct environmental struggles, but also by uniting them with all struggles against capitalist exploitation of nature and labor.

Unions are beginning to participate in coalitions with environmental and social justice organizations, in conferences on global warming, in international forums on social and environmental change, and are stepping up cooperation and union mergers across borders. This is a good start in the direction that workers of the

SOME POINTLESS ARGUMENTS ABOUT CLIMATE CHANGE

There are some issues about climate change that arouse passions and elicit arguments which are full of sound and fury but are pointless, at least in the short run.

Exactly how much of the climate change we are experiencing is due to human activity and how much is due to natural cycles? If human activity is adding excess carbon to the atmosphere, and so are natural processes, assigning a specific percentage of blame to the various factors won't make any basic difference.

Climate change preceded human mass production of carbon dioxide. It is a natural process, caused by a linked series of natural processes. However, we are making these natural processes worse—worse for human beings that is. Anything we do to lessen our impact will help us, no matter the original or ultimate cause. All we really need to know to make a start is that human production is, at the very least, contributing to the problem.

There are differing predictions of when we will hit crucial tipping points; some predict 10 years, some 50 years, some that we have already passed a tipping point. We may have 100 years before massive negative impacts, though that doesn't seem likely. But even if the tipping point is 100 years or more from now, do we want to pass on these environmental crises to our children and grandchildren? Do we want them to inherit a polluted natural world , inhospitable to human life, undergoing massive negative change in many natural systems, and much more difficult to remediate because of *our* actions? Let us step up our efforts to address these problems before they get to tipping points which we may or may not be able to predict with exactitude, but which we already know we don't want to reach.

Other arguments are similarly pointless when used as excuses to delay action. Does the most underlying cause of climate change reside in the tropics, in the Arctic, in the ocean currents, or in the stratosphere? Arguing about this will not make a big difference in deciding what we need to begin doing now. The answers are important in the long run, but the only way of knowing is to engage in much more research and action. Only more information, more research, more practice and implementation, and deeper understand-

ing will get us there.

The answer for now about many aspects of climate change is that we need to know much more, we need to act while finding out more, and we need to act to *enable* us to find out more.

Some insist that the main upcoming crisis is the soil; others that water is what we should focus on; others that excess carbon dioxide is the biggest deal. The point, however, is that these are all interrelated, and working on any of them will at least help ameliorate the others. The world is not often an either-or place, it is a place of cycles, of linked chains, of networks. If global warming is contributing to water resource problems, working on global warming is also working on water resources, and arguing about which one is going to be "the" most crucial is not important, not yet anyway.

We have to find ways to work on all these interlocked problems and issues simultaneously. If we don't, whichever problem we ignore will likely turn into the most crucial one sooner or later.

Another set of pointless arguments come from doomsday scenarios of the climate change skeptics. They predict, using zero-sum logic, that environmentally sound production and the limits on growth inherent in sustainable economics would rapidly throw the world economy (or the economy of the U.S., which for them is the same thing) into instantaneous economic depression. For one thing, they ignore the costs of global warming that we are already paying.

More importantly, investing in environmentally sustainable agriculture and production will create a great deal of economic activity, generate increases in the GDP, and create millions of new jobs. Those jobs and that growth will not be wasteful, unrestrained, unplanned, and resource-intensive, but will be economic growth just the same. It may not generate as much private profit, but will generate much more public good.

An example is the timber industry. Go back a few decades to the battles in the western U.S. over the spotted owl and restrictions on timber cutting. The timber industry was able to convince many timber workers that their jobs were being threatened by those "damn environmentalists." But the timber companies didn't have the best interests of the workers at heart—the companies were focused on unrestrained profit, unrestrained logging, and the cheapest methods of cutting more trees faster. The reality is that environmentally sustainable logging takes *more* workers, creates *more* jobs, and is better for economic development and growth especially for local communities, and also better for salmon runs, the spotted owl, and decreased erosion rates. Environmentally sustainable logging practices just don't create as much quick profit.

There is a fallacy in the thinking of some environmental activ-

Joel Nito/AFP/Getty Images

◀ **Filipino activists sunbathe in Manila during a climate change protest in a public park. The group demanded that local election candidates commit to renewable energy and stop ignoring the inevitable effects posed by climate change.**

ists too. They see production itself, and/or technology itself, as the problem, and so argue against all industry and technology, and blame workers for needing jobs.

Environmentalists speak of the so-called "tragedy of the commons," in which we have problems because individuals place their own short-term interests over the long term interests of all people. They supposedly do this because if they change, the pain of change will hit them immediately, but if they postpone change, then the pain to all people is somewhere in the future, or because individual benefit is immediate but the social cost is protracted and is not paid by the individual.

The real tragedy is the tragedy of the anarchy of capitalist production, of enshrining individual profit above planned social good. People don't need to make such choices, but sometimes the system leaves them no good alternatives. That is the fault of the system, not of "greedy people" or human short-sightedness in the abstract. When the system leaves people with nothing but individual choices about their own survival, of course people will make individual decisions to guarantee their immediate survival. But that is not the only alternative.

We do have a better choice—democratic social decision-making about, and action to solve, our collective survival needs—socialism. This needs cooperative politics, expanded public debate, expanded public power to implement change, economic democracy to make economic decisions in the interests of the majority, much more public knowledge about environmental problems and potential solutions, and ending the tyranny of private profit and private industrial and large-scale agricultural property.

Wait just a minute, I hear you cry. Haven't socialist "command" economies failed?

There are several major things wrong with this argument. First, capitalist enterprises are the very definition of top-down command economies within each enterprise, so this would condemn capitalism too if it was such a fatal flaw. This is even more the case since the development of so many large transnational corporations. Second, the restoration of capitalism in former socialist countries has been an unmitigated economic (and environmental) disaster for the vast majority of people, so the replacement of socialism by capitalism is a proven failure. That makes it all the more imperative to build democratic, ecologically informed, sustainable socialism. Third, we now understand better some of the objective limits on top-down command approaches to solving all economic challenges—the "butterfly's wings" aspect of Chaos Theory. Top-down management gets increasingly difficult the larger and more complex the system, and top-down micromanaging becomes increasingly counter-productive.

Some of the large-scale change we must create requires centralized financing and decision-making. The answer is not top-down command approaches for each and every problem, but only when that is an essential requirement. We need more centralism and planning, *and* we need more decentralization and individual initiative; we need more production but geared to sustainable human need rather than individual profit. Part of the solution lies in local democracy, in local efforts at land stewardship. The developing structures of rural community councils in Venezuela are an example of how to combine national decisions with increasing local input, control, and democratic activity.

SOME "SOLUTIONS" THAT WILL MAKE THINGS WORSE

We have already discussed the false solution of increased reliance on nuclear energy, and the illusory solution of biofuels from corn.

Another series of solutions that turn out to be false rely on making "us" safe in "our" locality, region, or nation. We can't solve problems in one area in isolation, because all our natural systems are connected to all other natural systems. The world is a global system, and environmental problems have been globalized even more than industrial production and distribution. Atmospheric pollution is present and increasing over the Antarctic, where there is no industrial production. This is because winds and weather patterns are no respecters of borders. Pollution of the oceans affects people in every country touched by the oceans, no matter where the pollution originates. So no one is safe unless all of us are safe.

The opposite problem is that some environmentalists turn themselves into crisis utopians and devise abstract and unrealistic ways of totally reorganizing the world, as if borders and nations were going to disappear instantaneously because bioregions cross most if not all borders. Their view of the scope of problems and the scope of necessary solutions is sometimes correct (we do need to resolve many issues on a bioregional basis), but the idea that we can devise governmental forms that will somehow develop automatically (without class struggle) leads down blind alleys and wastes time.

Many others who understand that fundamental change is needed nonetheless ignore or dismiss the working class as the main force for accomplishing that change. Some propose vague ideas of environmental activists not directly connected to any actual class struggle implementing fundamental change, just because we need change. These are forms of utopianism, ones that have good intentions and reach for optimism. But unfortunately, change doesn't happen just because it "should" or "must." There have to be real and powerful organized forces which propel that change. Social change starts from small groups of people, but has to reach, inspire, lead, and organize millions (billions when we speak of worldwide change) and they have to have the potential power to implement change. In our times, that is only the working class, which worldwide is larger than it has been at any time in history (though this is not to suggest limiting environmental struggles only to workers).

Some scientists who understand how complex and constantly changing nature is do not apply that same understanding to people. They look at the labor movement, for example, and complain that it is not sufficiently involved in struggles to solve environmental crises. Therefore, in their minds, the working class is "backward" and always will be.

They don't see that humans, groups of humans, and organizations of humans, all go through the same constant change that nature does. The working class, while it is uneven in how progressive it is on any particular issue at any particular time, and while environmental commitment varies from union to union, is increasingly coming to the fore in most positive social, economic, and political struggles. Most importantly, the working class is the only force that has the potential power to implement the basic, fundamental changes humanity needs.

SOME COMMON SENSE FIRST STEPS

While the following is not a comprehensive program yet, it does offer some ideas of what to do and which directions to go.

Contrary to the accusations of some skeptics, those of us who are worried about environmental crises are not pessimistic. Rather, we are profoundly optimistic about the ability of humanity to be proactive, to take positive steps to change our circumstances and to avoid environmental catastrophe. We are optimistic about the positive effects of combining personal decisions that individuals make (like recycling), social action (organizing a union or local environmental struggle), political action (demanding that politicians act on environmental problems), and global action (the Kyoto Accords), with the latest in scientific knowledge. Scientific knowledge by itself isn't enough; personal action and social struggle are necessary; no one without the others will get us where we need to go.

People debate whether adaptation or prevention is the way to go. Clearly, serious efforts at conservation would provide both functions, being both adaptive and preventative. Clearly, efforts of all kinds are needed—scientific, technological, political, economic, social, diplomatic. We have to do all of it, to some degree.

We need to learn the First Law of Holes—if you are in a ditch you don't want to be in, the first thing is to stop digging. This means that we need to take *immediate* steps to stop making the problems worse.

LESS CONSTRUCTION

We need to stop paving over the world; more of the ground needs to be porous. Unrestrained highway building, more and more massive parking lots, increasing numbers of runways, urban and suburban sprawl, all contribute to pollution, water problems, erosion, and flooding. Golf courses eat up productive land and huge amounts of water.

While there is a worldwide crisis of housing and humankind needs much more housing, we need to make sensible choices about what kinds of housing construction to use, where to build to minimize water usage, constructing houses for masses of people rather than megamansions for the super-rich, limiting urban and

suburban sprawl, and creating synergistic communities that provide more of the necessities of life from local areas wherever possible.

CHANGE OUR TRANSPORTATION SYSTEMS

One contributor to the release of excess greenhouse gases is plane travel. While it would be impractical to stop all plane travel, we need to stop building bigger airports, building more planes to carry more people more often, and paving over significant swatches of photosynthetic surface as we go. (The vapor trails from plane exhaust may contribute to global dimming, which has helped shield us from the worst effects of global warming thus far, so plane travel is not a total minus.)

Much of air passenger travel is business travel, and much of that is due to corporate meetings and sales and advertising efforts that are not socially necessary. Much air travel is military, and if we closed U.S. military bases around the world, that would cut down the need for air travel considerably. Another factor driving the increase in air traffic is the shrinking amount of free time that workers have, resulting in shortened vacations, and shrinking or eliminating time off to take care of family matters.

Air travel is the least energy-efficient and most polluting form of travel, and we need to find ways to reduce air travel. Make it more efficient, eliminate most military and non-essential business air travel, and provide alternate means of travel like fast railroads. More time off, longer vacations, and using travel subsidies for mass transit and railroad construction and repair (rather than for more highway construction and additional air travel capacity) would be better allocations of scarce resources, without greatly lessening the ability of people to travel.

We need to slow down the rush to find the cheapest labor possible based on our ability to transport everything over huge distances using non-renewable resources in the process, whether by air, by ship, and/or by truck. Just because we can ship many things for long distances doesn't mean we should.

Hybrid cars will help more if they become more affordable for more people, and there are important experiments with electric and compressed-air cars which may in the future give us even better alternatives.

MORE SCIENCE

One crucial step is to significantly increase our scientific research into all aspects of climatology. Some of the warnings about horrific consequences from global warming are peppered with "maybe," possibly," "it seems likely," "we don't know yet, but," and so on. The solution is not to throw up our hands and say we don't know enough so there's nothing we can do. We can learn more—that is what humans have been doing for many thousands of years. Knowing more can lead us to better decisions, lead us to improve the solutions we've already started, and keep us from "solving" one problem while making others worse.

Ahmad Zamroni/AFP/Getty Images

▲ **Activists display placards during a demonstration in Jakarta to mark the World Environment Day. Indonesia is particularly vulnerable to the impact of climate change as global warming threatens to raise sea levels and flood coastal farming areas, threatening food security.**

Some "global warming skeptics" tell us we don't need to worry so much, technology will come along and help us solve the problems before they overwhelm us. They may be right, but only if we actively pursue helpful technologies that can be part of the solution. We can't sit around waiting for technology (or the market) to solve the problems for us by magic.

Technological development is too often seen in a linear fashion rather than dialectically. For example, we are seeing that too often pesticides increase pests; hospitals become the foci of infection; fertilizers deplete the soil they are supposed to enrich; the Army Corps of Engineers builds levees but increases flood damage.

> The capitalist system is an obstacle to the solutions our survival requires. Only a system that puts the needs of people and nature ahead of profits will ultimately work, a system that uses the human measures of survival and the greatest good for the most people, rather than the short-term profit of the few at the long-term expense of everyone, including the capitalists themselves.

We need to utilize technology, science, and development to increase unity with natural systems rather than to increase futile attempts to control nature or focus on making fast, short-term profit. Planting beans mixed with tomatoes protects the tomatoes from late blight, but it doesn't sell tractors, it lessens the need for the commodities of the chemical fertilizer and pesticide industries, so this common-sense, simple additional planting technique is often ignored. We can introduce horses into orchards to eat the weeds, and leave straw in the fields to encourage hunting spiders that will kill pests—these too are ideas that can't be sold and resold, so they are not promoted by corporations.

Instead, Monsanto and other chemical companies are marketing genetically-altered seeds designed to be incapable of natural reproduction, so farmers have to buy them anew each year from the manufacturer—which harms the long-term economic viability of small-scale farming. They also claim that these seeds are more pest-resistant, but this hasn't proved to be true in the real world. Such short-sighted nature-altering processes may be profitable for the corporations in the short run, but they do not help agriculture, farmers, consumers, the earth, nor the economy in the long run—another example of the ways that capitalism is unnecessarily destructive of natural systems.

SOLAR-BASED ENERGY

One solution is the large-scale development of wind, biomass, and solar energy to replace our dependence on fossil fuels. If the U.S. government guaranteed that it would buy solar energy cells on a large scale, it would become economically feasible to mass produce them in a way that would bring the unit costs down to an affordable level for many more people. Government purchases could be used to shift government buildings to solar power, saving public funds within a few years. A guaranteed government market could bring down prices for everyone.

Ultimately, solar, wind, and biomass energy all come from the sun, and this will be available for millennia to come. We need large-scale public investment to help create economies of scale in the functionality, production, distribution, and installation of these systems. We also need more research into wave, tide, and geothermal generation of energy—none of these offer a quick way out but if we want to have options in the future, we better study and experiment more now.

PLANT MORE TREES

Other solutions we should start on right away include those that require a long time to mature—reforestation being a prime candidate. Forests take many decades to mature to the point where they will have a serious positive impact on filtering carbon dioxide out of the atmosphere. So we better get to planting.

We need to stop cutting down the remaining forested areas of the world—the Amazon, Siberia, Indonesia. Again, reforestation by itself will not approach the threshold needed to seriously reduce carbon dioxide in the atmosphere—this is only one aspect of the comprehensive program we need.

Reforestation can, however, help with several problems at once—it can contribute to soil formation and limiting erosion in addition to absorbing carbon dioxide and emitting oxygen, plus provide habitat for great varieties of animal and insect species. By looking for programs that work at the intersections of multiple systems, we can get increased benefits from what we do.

CUT METHANE

Even though carbon in the atmosphere is the most significant and longest-lasting cause of global climate change, we may gain time by focusing first on the production and release of methane gases. While methane stays in the atmosphere for about 10 years as opposed to over 100 years for CO2, methane has a much greater capacity to absorb heat, intensifying the greenhouse effect more than CO2. Limiting methane won't solve our longer-term problem, but it can help delay the tipping points that threaten to destroy the ability of the planet's natural systems to recover.

We need to reduce the amount of material going into landfills (which create and emit methane), capture and reuse methane produced by existing landfills, and change our production, distribution, and packaging processes and habits so that so much waste is not produced in the first place. If we start to shift away from so much meat in our diet, that reduces the market for more cattle, which produce a huge amount of methane. That will gain us time.

CUT BEEF

The production of beef not only creates methane emissions from cattle, it also rests on top of a pyramid of significant land and grains to feed the cattle, all based on massive water consumption for the land, the grain, and the cattle. Cutting back on beef production will reduce pressure on water systems, pressure to cut the rainforests of the Amazon for grazing land, pressure on people's diets, and on the costs of refrigeration and transportation of beef. It doesn't require everyone to become a vegetarian, just scaling back on beef consumption.

LESS PLASTIC

We should use plastic, based on petroleum, where it is a necessary component of an essential product, such as medical equipment. Plastic bags at the grocery store don't meet that standard. Plastic egg cartons rather than cardboard don't meet that standard. Pop bottles don't meet that standard. Double and triple layers of packaging don't meet that standard, no matter how shiny and brightly-colored they are.

END MILITARY EXPORTS

Stopping all exports of military goods will cut environmental destruction from the use of those weapons, will cut pollution from their production, will cut the amount of waste material left after weapons are used. We can start by immediately ending all subsidies to military manufacturers which are disguised as "foreign aid."

ENFORCE EXISTING LAWS, IMPROVE TRADE STANDARDS

Fully fund the EPA and similar state agencies to enable them to hire and train enough personnel to do the jobs they are mandated to do. We can renegotiate international trade agreements so that labor rights and environmental restrictions can't be overruled by supranational committees of trade organizations, heavily weighted with corporate officers and representatives.

BE PRECAUTIONARY

Another much needed change in how we impose technology on nature is to institute the precautionary principle wherever possible. We don't know, for example, the exact effects of the some 4,000 inorganic compounds introduced into the workplace in the U.S. each year. It is a safe bet that many of them have at least some carcinogenic or endocrine-disrupting effects on the workers using them. Taking sensible precautions even before we know exactly which compounds produce which negative effects is just common sense, including much more testing before exposing workers to unknown health risks.

We know that the presence of certain amounts of chemicals and particulate matter in the atmosphere leads to more respiratory

problems. Prudence dictates that we err on the side of caution, to reduce such chemicals and their use and reduce particulates even before we can prove a direct connection between a specific factory and its emissions and specific people's health problems. Instead, now we act as reckless bulls in a china shop, randomly breaking things around us before we know how they are connected. It is harder and more expensive to solve health problems after they are created than to prevent their creation in the first place.

RESTRAIN POPULATION INCREASES

Some blame the increase in world population for all our environmental problems, and urge profoundly anti-human solutions. But the problems lie not just in the numbers of people but also in the technological, industrial, and agricultural methods we use (and the unequal and unjust social systems we set up and impose). Just having fewer people but still producing and distributing food and industrial goods in the same ways is worse than no solution at all, because we would have to turn ourselves into monsters, consigning millions or billions of people to unacceptable conditions and death. And this would still fail to save humanity.

That said, one of the common-sense measures we should take right away is to work much harder at population control—funding birth control around the world, improving the economic and social lives of women (the single most effective method of restraining population growth), guaranteeing abortion rights and information, and providing incentives for having fewer children.

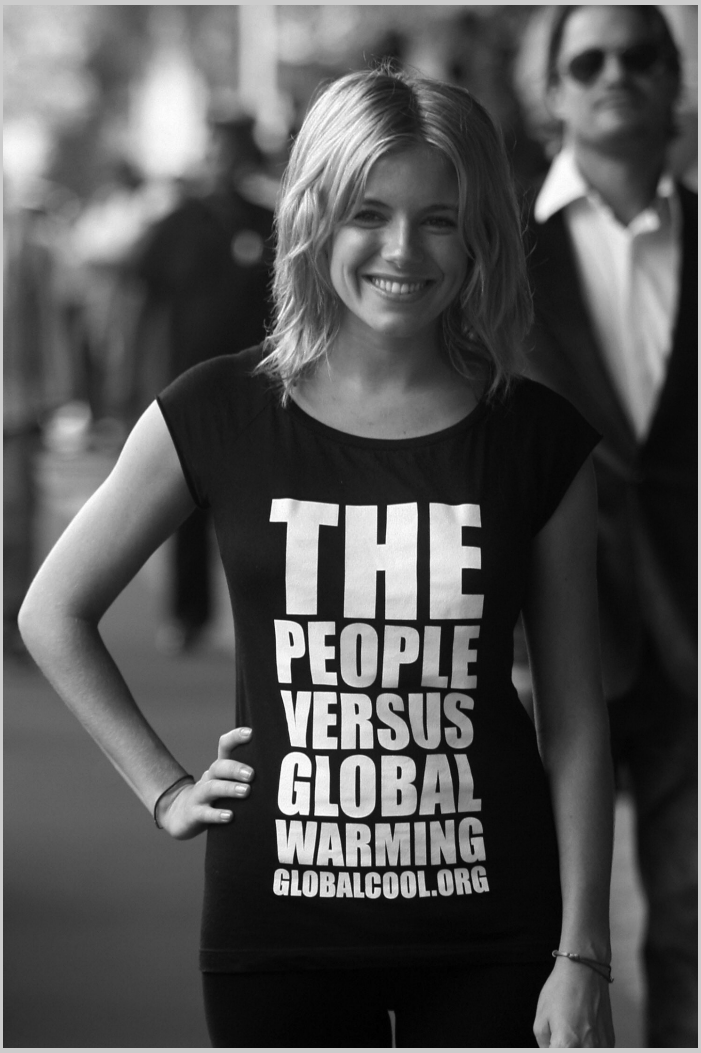
We are headed for serious adjustments, either planned, involuntary, or both, which are necessary to recalibrate the balance between humans and the nature on which we depend. If we take steps to lessen the number of people at the same time as we take steps to change our agricultural, industrial, and distribution processes, that can provide positive synchronicity, reinforcing the positive benefits. If we wait until nature does it to us, most of the synchronicity will impose negative impacts on human life.

FURTHER STEPS NEEDED

REDEFINE PROGRESS

If we succeed in restraining the birth rate, and our health systems continue to extend human longevity everywhere, we will have an older world population. This is already happening in most developed countries where most increases in population come from immigration.

This provides added reasons to redesign industrial processes and work: to make production more efficient, to eliminate pollution that particularly harms people with respiratory problems (many of whom are older), to create more jobs that aren't totally physically draining, to end speed-up and extend vacations, and to create



Pal Pillai/AFP/Getty Images

▲ British actress Sienna Miller is an ambassador for environmental protection organization 'Global Cool' which showcases effects of global warming.

flexible working conditions to allow a broader range of people of all ages and abilities to live longer productive and creative lives.

Improving quality for all is not the same as continual expansion of quantities of commodities being sold worldwide. We must shift the paradigm of what constitutes a rising standard of living to focus more on increasing the quality, creativity, and health of life rather than on constant consumption of more goods and more energy resources. This is another reason why capitalism is incapable of making the changes needed, since capitalism is all about continually expanding markets for commodities, expanding production of commodities, expanding sales of commodities, and expanding the profit made from selling more commodities.

INDUSTRIAL REDESIGN

We need to redesign many industrial processes from the ground up, to prevent the creation of pollution in the first place, to reduce waste of all kinds, to use resources more wisely, and to produce for human needs rather than profit. There are examples already of this, some of them even economically feasible under capitalism. The goals of such redesign include reducing and eliminating toxic chemicals; eliminating pollution; reducing and recycling waste products; capturing and reusing lost heat and other energy; and creating synergies where the waste products of one industry provide the raw materials for another nearby industry.

AGRICULTURAL REDESIGN

We also need to redesign many of our agricultural practices. Land is becoming poisoned with salt; erosion is increasing, especially in delta areas which have been deprived of their natural silt and water flows by dams and irrigation projects; and desertification is accelerating at an alarming rate. We are wasting water to grow crops in places that require altering the natural flows and cycles of water and rivers, or for cosmetic reasons in places like Las Vegas and Phoenix. We need to reverse the increasing dependence on chemical fertilizers (the production of which drains energy and oil, in addition to the long-term harm it causes to the soil). Adoption of organic farming methods, of no-till and conservation tilling methods, increasing crop rotation and crop diversity, instituting large-scale composting, planting continuous ground cover, respecting the contours of the land, and more experimentation with small-scale intensive farming, would all help to restore the soil, decrease fuel costs from mechanical plowing and shipping, decrease costs for chemicals, decrease erosion rates, and in the process rebuild soil that can absorb more carbon, helping to buy time to solve global warming.

TRANSPORTATION REDESIGN

Redesign our support systems, especially transportation and distribution, to minimize the creation of pollution of all kinds and to reduce the drain on non-renewable resources. This means large, long-term investment in a renewed railroad system for the long-haul transport of people and goods. It means not letting temporary, profitable cost-efficiencies drive us ever farther down the road of globalized excess transport of food and commodities. It means not letting U.S. auto companies get away with continuing to produce vehicles with lower standards of fuel efficiency than European and Japanese automakers. It means building bus systems with hubs on the edges of cities, which connect to urban transit systems but save time and energy by avoiding busses having to negotiate downtown traffic, and have bus lines stop in many more small communities, providing more transportation alternatives to cars. We need these steps rather than the continuous shrinking of our rail and bus systems which we've experienced over the past decades.

ELIMINATE INTERNATIONAL DEBT

Forgive the debt of poorer countries. Right now, the need of many countries for hard currency to repay the interest on massive international debt is driving the transformation from agriculture for local consumption into production of agricultural goods for the export market. Countries that used to be self-sufficient are now forced to import food. (The banks which lent the money in the first place have mostly been paid back many times over, but because all the payments have been primarily interest instead of principle payments, the debt remains long after a reasonable profit has been made. This is a modern form of usury, stealing from the poor to

overcompensate the already obscenely wealthy.)

STOP MILITARY PRODUCTION

Step-by-step, reduce and then eliminate most military production, which is completely wasteful of resources we desperately need for survival. War is not only viciously destructive of people, it is destructive to the environment and to economies. Eliminating military production and transforming our research systems to focus on human needs rather than military research will direct much needed scientific, technological, and research resources to the problems we most need to address.

> Socialism is a necessary, essential aspect of the changes we need to make to protect the survival of our species, but it is not a sufficient condition by itself. Socialism is necessary to mobilize the resources of whole societies to fund the massive changes we need to make. But just because socialism can do that doesn't mean it will. Something more is needed.

Nuclear weapons are the most destructive military production of all, so we should eliminate them step-by-step. Instead, currently the military is trying to design "battlefield nukes" which would be small enough that armies could actually use them. But once used, what limits the use to small bombs? This is the wrong kind of research for the wrong kind of solution to the wrong problem—a total waste. In the research, the production, and especially the use, this is the very definition of a lose-lose-lose proposition.

SPREAD HEALTH AND EDUCATION

Even if Bush's intention really was to spread democracy (I think his intention consists only of rhetorical flourishes for public consumption), even then, invasion, occupation, and militarization don't bring democratic results. Neither do the World Bank/IMF Structural Adjustment Programs (cutting public services for health, water, sewage, and education, and privatizing everything) result in democracy (nor in lasting economic improvements for the poor). Neither does the neo-liberal prescription of "the market" as the supposed solution for all problems.

The way to spread democracy is first to spread education, access to potable water, adequate sewage systems even (especially) in slum and "informal housing" areas, and health care. Decreasing the skyrocketing infant mortality rate is not just the right, humane thing to do, it is an effective population control measure.

Creating a world where people have time to be citizens, a world where improving the quality of life is more important than increasing the quantity of goods, where immediate survival needs don't trump everything else for billions of people, will be a world where people can take the time to learn, think about, and act on the long-term survival needs of humanity.

THE WORLD CAN'T AFFORD THE RICH

The burden on the entire world due to the super-rich and of international finance capital is too great—we need that money (which workers created in the first place) to implement systems that benefit all and work for the survival of humanity. In order to pay for the changes that humankind needs to make, we need to get money from the people and institutions that have it—the super-rich, the international banks, the major multinational corporations, the financial speculators.

A world of equality and justice is necessary to address climate change. If we ask only the majority (workers and poor people) to make sacrifices, while the rich and super-rich continue to suck us dry of the fruits of our labors, we will never win enough people to tackle fundamental change and we will never have enough money to finance that fundamental change. Those who have gotten the most benefit out of the economic system that led to the climate crisis need to pay the greatest share of the costs to fix the problems created by that economic system."

ENVIRONMENTAL SOCIALISM

Real economic democracy; elimination of the waste of profit for the already super-rich; elimination of profit as the only worthwhile economic measurement; new forms of industrial development with less impact on natural systems; improved health, job security,

democracy, education; and more social justice—these are some of the benefits of an environmentally conscious socialism. Collective democratic organization of society, collective power to make decisions affecting society including economic decisions, and collective participation in the carrying out of those decisions are all socialist principles we need to enable us to tackle today's environmental problems. As the CPUSA Environmental Program, *People and Nature Before Profits* says: "The inclusion of environmental concerns in the working-class struggle today ensures that they will become foundations in the building of a socialist economy that will operate in

AN UNDEREXPLORED QUESTION

We are learning more about how human activity can drive nature past natural thresholds to climate changes destructive of human and natural needs. Science is learning about the existence of two states of nature's climate system—warm periods alternating with ice ages. The earth has also experienced protracted periods where the climate swung repeatedly between hot and cold.

Not enough has been done yet to learn what tips nature back into an ice age. We know that relatively warm periods have alternated with ice ages, and we know that carbon dioxide accelerates and intensifies those natural systems that increase temperature. But we don't fully understand what causes warm periods to "flip" to ice ages. Some of the causes relate to cycles of the tilt, wobble, and orbit of the earth, but we don't yet know what all the other contributing factors are. So we don't know whether or not the human activity driving global warming will just lead to an ever-hotter climate, or will ultimately lead the climate to "tip" to an ice age. Needless to say, ice ages are no more compatible with thriving humanity than extremely hot periods would be.

This is why we need to study climate change and all quantitative and qualitative transformations within climate systems, not just global warming. We don't yet understand all the interconnections which can have highly negative impacts on humanity.

We don't know enough yet, and *we don't want to find out by committing irreversible environmental damage*. This is the ultimate meaning of the precautionary principle—we must stop ourselves before we challenge to extinction the ability of the ecosystem to reproduce our water, food, and resource supplies. Once we start to experience catastrophic consequences, understanding may be too late to do us enough good.

SUMMARY OF BASIC DIALECTICAL THINKING

All life is matter in motion. All life consists of systems of interlinked processes, which affect each other and the whole web of life. Within each multidirectional process there are contradictions which drive struggle, change, and motion. Processes go through small, quantitative changes, and also through qualitative leaps. Human processes are based on and interconnected with all other natural processes, so environmental change requires economic and social change. Change is the only constant. Scale matters, the tension and unity between form and content matter, internal and external forces interact, and time, place, and circumstance impact the rate, scale, and even the nature of change.

Stephen Morton/Getty Images

▲ **Supporters of Democratic presidential candidate Sen. Hillary Clinton (D-NY) and the cause to address global warming stand outside the front gate of the Citadel before the CNN, YouTube Presidential Debate July 23, 2007 in Charleston, South Carolina.**

SUMMARY OF ECOLOGICAL NECESSITY
The whole world is one interconnected web of human and natural processes. Human activity interacts with the rest of the natural world. The processes of nature go through small, quantitative changes, and also through qualitative leaps which lead to fundamental transformation. Humanity is approaching several crucial tipping points, beyond which recovery and acceptable human life become much more difficult. We have to act in advance of complete and total understanding of all processes involved, because to wait has unacceptable risks of fundamentally transforming the natural world upon which we depend, in ways that will harm or end humanity.

Just changing one bad practice or production method is not enough; we need a series of connected, world-wide assaults on emissions of methane and carbon dioxide. This needs to mesh with improved water usage and agricultural solutions, and ending other forms of pollution. We shouldn't use up nonrenewable resources, and we can't act as if the waste-absorbing capacity of the natural world is infinite.

CONCLUSIONS

Life matters, human life matters, and the natural world which life requires matters. Significant shifts in what and how we produce, and in how we package and distribute goods, are necessary for our survival as a species. We have to redesign our industrial processes to eliminate the creation of pollution, and take other steps to decrease the impact of human activity on the natural world. We have to restore and rebalance our relationships with nature, including altering many of our agricultural practices.

> We must shift the paradigm of what constitutes a rising standard of living to focus more on increasing the quality, creativity, and health of life rather than on constant expansion of the consumption of more goods and more energy resources.

The collective problems of humanity require the collective thinking and action of humanity. That is part of what democracy is about, including real economic democracy: the mobilization of our collective intelligence, ability, and activity to solve our shared problems.

Capitalism has proven incapable of the comprehensive planning, social investment, and human decency required to solve human-caused global climate change. Capitalism operates on several deadly assumptions: that nature is "free," that natural resources are limitless, that the waste-absorbing capacity of nature is infinite, and that progress equals more commodities, markets, sales, and profits. Environmental problems, like social problems, will not be solved without changing the economic system which generates and exacerbates those problems.

Transforming our economic system to socialism is a crucial part of the environmental, industrial, agricultural, and distribution changes we need to make, but by itself this won't be enough. We need to integrate socialist economics with environmental science, understanding the limits the natural world places on industrial development and production. In order to do this, we have to change the ways in which knowledge is created, owned, financed, disseminated, and utilized. Human knowledge, and human and plant genes, need to belong to all of us.

Workers of city and countryside, of hand and brain, the vast majority of the world's people, will benefit from such a program of fundamental change in many ways, including from the improved prospects of human survival. That survival requires that we change our economic and social relationships with each other as well as with the natural world.

Engels said that "Freedom is the recognition of necessity." Only by recognizing the restraint required of us by natural systems can we become truly conscious factors in improving the world for ourselves and our descendents. Only by recognizing environmental imperatives will we be free to make the right choices for humanity's survival.

SUGGESTED READINGS

ENVIRONMENTAL AND SOCIAL ECOLOGY, SOCIAL CHANGE AND CHALLENGES

There is a rapidly growing body of literature on environmental issues, and many of these address in detail of the causes and realities of climate change in ways that this essay can't do.

In my opinion, the single best book on environmental issues, though no longer up-to-date, is *Making Peace with the Planet* by Barry Commoner.

The following books happened to be the ones I read before and during the writing of this essay; they informed, inspired, and challenged me to write this piece. None of the authors are responsible for any mistakes I've made or even for any of the analysis I present, nor does inclusion here imply an endorsement of each and every aspect of these books, nor that they would endorse my conclusions.

Collapse by Jared Diamond, about previous environmental destruction of civilizations

When Rivers Run Dry by Fred Pearce, about the water crisis

With Speed and Violence by Fred Pearce, about environmental tipping points

Field Notes from a Catastrophe by Elizabeth Kolbert, about global warming

Planet of Slums by Mike Davis, about the problems of rapidly escalating urbanization

The Beak of the Finch by Jonathan Weiner, about evolution that we can see and measure

The Enemy of Nature by Joel Kovel, about why capitalism can't solve basic environmental problems

Red Roots, Green Shoots by Virginia Brodine, about Marxist environmentalism (edited and with an introduction by Marc Brodine)

Marx's Ecology by John Bellamy Foster, about returning to Marx's analysis of environmental and agricultural systems

Dirt by David Montgomery, about soil and agricultural crises

People and Nature Before Profits, the CPUSA Environmental Program 2nd Edition, by Dave Zink and Marc Brodine, about the nature and causes of environmental crises, and the program needed

The Road to Socialism USA, the Program of the CPUSA, about strategy from now till socialism

Cradle to Cradle by William McDonough and Michael Braungart, about the redesign of industrial processes

The Two-Mile Time Machine by Richard B. Alley, ice ages, Greenland ice cores, and world climate

Complexity, Life at the Edge of Chaos by Roger Lewin, about attempts by scientists to discover and explain the patterns of the world's pervasive complexity

The Weather Makers by Tim Flannery, about climate change

DIALECTICS

Below are some books which deepened my knowledge and understanding of dialectical materialism.

Materialism and the Dialectical Method and *Philosophy for Socialists* by Maurice Cornforth, good introductions to Marxist philosophy

Dialectical Materialism by David Guest, a British philosopher who died fighting in Spain, another good introduction to Marxist philosophy

Elementary Principles of Philosophy by Georges Politzer, a French philosopher who died as a Resistance fighter, a series of lectures for workers

Philosophy and Class Struggle by Dialego, a South African explains how Marxist philosophy applies to their liberation struggles

The Dialectical Biologist by Richard Levins and Richard Leowontin, about the dialectics of natural systems

Dialectical Materialism and Modern Science by Kenneth Neill Cameron, a review of the connections between developing science and dialectical materialism

Man Against Myth by Barrows Dunham, application of philosophically rigorous thinking to common myths and misconceptions

Reader in Marxist Philosophy and Dynamics of Social Change by Howard Selsam, David Goldway, and Harry Martel, compendiums of quotations from Marx, Engels, and Lenin, organized by subject

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Mike Clarke/AFP/Getty Images

▲ **Environmental activists in Hong Kong, China call for the China Light and Power Company to pledge to reduce greenhouse gas emissions by using less coal in electricity production.**